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[OFFICIAL NOTICE.]

November Meeting, Society of Gas Lighting.

SOCIETY OF GAS LIGHTING,
OFFICE OF THE SECRETARY, Nov. 2, 1893.

The next regular monthly meeting of the Society of Gas Lighting will be held at the works' office of the Newark (N. J.) Gas Company, at 3 P.M., November 9th.

F. S. BENSON, Secretary.

BRIEFLY TOLD.

OBITUARY, WILLIAM COMBE.—In our issue for last week was printed a brief announcement of the death of Mr. William Combe, whose demise occurred at his residence in this city on the afternoon of Sunday, October 22d, the sad sequel to an illness that lasted for many months. William Combe was born in Cugar, Fifeshire, Scotland, on October 14th, 1824, and emigrated to this country, with the other members of his family, who arrived in New York in 1833. His education was acquired at the public schools of the city, and on its completion (1841) he entered the service of the Manhattan Gas Company, having secured employment in the meter department of that corporation, the meter shops of which were under the supervision of the late Samuel Down. After three years spent in the meter shops, where he attracted the attention of his superiors by his carefulness, diligence and urbanity, he was appointed clerk of the 18th Street Station of the Company, and filled that position to the entire satisfaction of his employers until 1853, the year which marked the completion of the Company's East Side Station on 14th street and East river. He was appointed Superintendent of this division of the Company's manufacturing plant, a post that was retained by him until the merger that resulted in the formation of the Consolidated Gas Company. He remained in charge of the station under its operation by the Consolidated Company until 1886, when he resigned from its service to enjoy the rest that is the portion of those who have labored faithfully and lived reasonably. Mr. Combe was one of the original members of the Society of Gas Lighting, and was its Treasurer for some years; in fact, he only relinquished that trust last September, the impelling motive for his action being continued and progressive bodily failure. He was an active member of the Society and a constant attendant at its sessions. Deceased was a man of very even habits, quiet and unobtrusive, though holding to opinions with suave tenacity. He was a conservative and judicious manager, and his administration of the affairs of the "Fourteenth street Station," which constituted in itself a gas plant larger in point of manufacturing respect than nine-tenths of the separate gas works of the country, was capable and successful. As a controller of workmen no man could possibly have been more discerning and just, and they appreciated his fairness and impartiality. In fact, it is "history" around the station that during the third of a century that he managed its affairs no one ever heard him utter a decision that was conceived in anger. The funeral services were held at his residence, on the evening of October 25th, and these were largely attended by members of the Society of Gas Lighting, representatives of the manufacturing and office divisions of the Consolidated Company, and many relatives and other friends. Interment was made on the following Thursday in the Sleepy Hollow Cemetery, Tarrytown, N. Y., where the Combe family burial plot is located. A widow survives him.

THE ELECTRIC LIGHTING OF THE FAIR.—Of course all of the world has heard about the wonderful beauty of the effect of the incandescent electric lighting of the buildings during the World's Fair, and electrical touters have lost no opportunity in assuring those who were not at the great show, as well as those who did visit it, that the aforesaid incandescent electric lighting was a marvel in every sense—as to effect, completeness and profuseness of service, and in point of cost to those who had to pay for the effect, service and so on. There can be no doubt about it that many fanciful and really beautiful effects were produced, but as artificial lighting is looked to mainly for the aid that it gives to one "to see in the dark," it is on the whole fair to assume that with light, as with almost everything else, the remark "handsome is that handsome does" applies. It is all very well to be told that the incandescent electric lighting of the magnificent buildings at Jackson Park was beautiful and effective, but that verdict seems to have been mainly rendered by a jury composed of those who were interested one way or another in its generation and supply, for some of the users thereof and payers therefor, on the other hand, are decidedly on record to the contrary. Thus it becomes a question as to who was right, the supplier or the purchaser. It is

hardly to be expected that the seller can as readily see the blemish in his goods as one who figures as the buyer, nevertheless it is not altogether out of line for those who look on, quite outside the category of seller or buyer, to hold that something must be amiss when many of the buyers of incandescent electric lighting assert that the illumination afforded them by the World's Fair Company was "inferior," and "had not been maintained according to the contract." However, just to show that something was amiss, we print the following excerpt from a Chicago newspaper, dated October 27, which was mailed to us a few days ago:

"A committee of the national organization of State Executive Commissioners, headed by Mr. Stevens, of Michigan, waited on the Council of Administration yesterday, and also on Auditor Ackerman, and presented the ultimatum of the States regarding pay for electric lighting by the Exposition. It took the form of the following resolution, which was left with the officials named:

"'*Resolved*, That the several State World's Fair Boards using electric lights in State buildings do pay to the Exposition Company, and adjust the electric light question at the rate of $1 per lamp per month for the actual time of service of each light available for use, and that to those States that have paid a sum in excess of $1 per light per month the excess so paid to be refunded to such State or States, and that the collection of any greater or further sum be resisted by said Boards.'

"The resolution was preceded by a preamble declaring that the lights were inferior, had not been maintained according to contract, and that they were not worth the contract price of $1.33⅓ per lamp per month. The resolution was signed by the Commissioners of *all* States that have had the Exposition electric lighting service in their buildings. The original contracts called for lights from May 1st to the close of the season, at the rate of $8 per lamp for the season. As the lights were not furnished until about the middle of June, the Exposition officials offered a proportionate rebate for the first six weeks. This was not deemed a sufficient concession, as it was claimed the quality of the lighting was poor, and the State Commissioners have decided to resist the payment of bills unless their ultimatum is accepted."

This is a pretty severe arraignment of the light, the peacocky qualities of which have been so persistently dinned into the general ear; but alas—and that ornate bird has been credited with the knowing thereof—there's more to the peacock than his tail. In fact, his feet are painfully in evidence as stumbling blocks to his being regarded as a thing of complete beauty. And so it would seem with the beauty of the Exposition Company's incandescent electric lighting—'twas pretty enough, but rather unserviceable; very much like the peacock. His tail is harmonious enough, but he could do without it. Not so, however, as to his lower extremities, which are admittedly inelegant, but he could not get along very well without them. There might be some hope for argument as to the soundness of the quality of the lights furnished by the Exposition Company to the States' buildings did the Commissioner of a single State fail to give his assent to the ultimatum, but it will be noticed the Chicago paper says the document "was signed by the Commissioners of all States that have had the Exposition electric lighting service in their buildings." Not to put too fine a point on it, it is an open secret that the electric lighting of the interiors of all the buildings on the Exhibition grounds was woefully inefficient and decidedly expensive.

ANOTHER "INVESTIGATION" OF THE WASHINGTON (D. C.) GAS COMPANY.—It seems that the country at large is to be called upon to again pay the expenses of a committee that have been deputed by Congress to scrutinize the affairs of the Washington Gas Company, for the purpose of discovering "whether or not the said Company is in any wise violating the implied purpose of the franchise granted it." The nominal prime mover in this instance is Mr. Outhwaite, of Ohio, who we believe has no other interest in the city of Washington than to represent in Congress the constituents of what we may term the Columbus district of Ohio. Nor does it appear that any of the residents, of the gas consuming class or otherwise, of Washington, have urged this investigation; still they are to have it, as they have had many similar "investigations" thrust upon them in the last 20 years. It may be that the average Washingtonian does not know when he is being well treated by a local Company, and it seems it is only on this hypothesis that Mr. Outhwaite's resolution for investigation is defensible or explainable; still the average Washingtonian would likely feel somewhat put out were such a charge bluntly put before him. We have no fear that the proprietors of the Washington Gas Company can demonstrate that the "implied purpose of the franchise" they enjoy is not being violated "in any wise;" still common decency would seem to require that they be held responsible only to the inquiries of those whom they serve, instead of being at the subpœna nod of any and every representative of a backwoods or other district in Congress.

[OFFICIAL REPORT—REVISED BY THE SECRETARY—CONTINUED FROM PAGE 519.]

TWENTY-FIRST ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION.

HELD AT CHICAGO, ILLS., OCT. 18, 19 AND 20, 1893.

FIRST DAY—MORNING SESSION.

READING THE PAPERS.

The President—The first paper will be that by Mr. George Treadway Thompson, of St. Louis, Mo., on

THE REVIVIFICATION OF IRON OXIDE.

In purification, as in all other divisions of gas manufacture, it is important that records of work should be full and complete. With lime as our material we have little to record save the percentages of impurity in the crude gas, and the quantity passing the set of boxes between changes with its quotient of purification per bushel. An occasional analysis of the lime supplied is of value in assuring that the material is of uniformly good quality, but beyond this little is necessary. In the use of oxide of iron, however, considerable detail may be followed with advantage without reaching the point at which such work becomes clerical drudgery. Some parts of the record to be described are regular practices at a number of plants, but in its entirety I have not seen the system employed or described elsewhere.

For convenience of reference the boxes of each set may be permanently lettered (as A, B, C and D, or with the points of the compass), the several beds of oxide be indicated by Roman numerals, and where more than one set of purifiers is employed the sets be indicated by Arabic numerals. In addition, it is convenient to denote the rotation of boxes in each set by discs, on which are painted numbers, showing the positions in the set occupied by the several boxes, each disc being hung next its box or placed upon its cover, and all three being moved a quarter turn toward the right when the set is changed. Thus, Box C of Set No. 2 might contain Bed VII., and be the first or inlet box of that set.

One portion of our purifier record book is ruled as below to show the sequence of the changes. When more than one set is employed, an account of what each bed is doing can of course only be obtained by having a separate station meter for each set. Most large works are so provided. [See top of next page.]

Another portion of the book is devoted to the record of the individual beds, several pages being left for each Roman numeral, any alteration of its position or condition being posted here immediately following its entry in the part of the book first described. In other words, the general record may be considered a journal, and the individual record of beds be treated as a ledger. To credit each bed with its due proportion of gas purified between changes, it is necessary to assume some factor of the estimate; and a convenient method is to regard the work done by the bed when in the position of "first box," or foul box, as the actual purification accomplished. This assumption, in the absence of extraordinary irregularities, is likely to be quite near the truth in the life of the oxide; and if occasionally checked by determination of the sulphur thrown down and the known average of impurity in the gas, estimation on this basis will be found fairly correct. In this record the pages devoted to Bed IV., for example, might commence thus:

Homemade Borings-Oxide, Mixed in August, 1891.

Fe_2O_3, 38.7 per cent.[1] Weight per bushel, ready for use, 41 lbs.

	Purified.
In A No. 1, Nov. 2	1,259
In B " 2, " 24	3,627
In D " 2, Dec. 20	8,660
Revived by steaming in box, Dec. 24	....
Removed to floor, Jan. 8	25,322
Soluble sulphur	....
Etc., etc.	

Supplementing the Record Book, which is essentially for office reference, a slate is kept in the purifier house bearing a diagram of the boxes and the reviving floors permanently cut upon its face, and on this the location of each bed is pencilled and the necessary alterations made whenever a bed is moved. Then, with a shingle chalked with the Roman numeral stuck into each idle bed, the location of each heap and the character of the oxide in use in each set are always apparent, and there is no difficulty in tracing throughout its life every particle of our material.

1. A method of estimation for Fe_2O_3 is given in "King's Treatise on Coal Gas," Vol. II., p. 26.

Set Number One.

Box.	Date Changed.		Meter Registry.	Gas Purified.		Oxide.		Remarks.
				Bet. Changes.	Per Bush.	Out.	In.	
A	4 P.	Dec. 1	288211000	.....	.....	III.	III.	Steamed off box.
B	10 A.	" 5	291715000	3,504,000	6,257	XVIII.	XIX.	Bed IV. contained 54 per cent. sulphur.
C	11 A.	" 6	292645000	930,000	1,660	IV.	VII.	Discarded as spent.
D	9 A.	1893. Jan. 20	330197000	37,552,000	67,057	XV.	XX.	
A	12 M.	" 22	331930000	1,733,000	3,095	III.	XVIII.	
B	9 A.	Feb. 9	345737000	13,807,000	24,655	XIX.	XV.	
C	4 P.	" 17	351214000	5,477,000	9,780	VI'.	XII.	Average H_2S at inlet, 1.3 per cent.
D	2 P.	Mch. 6	362336000	11,122,000	19,861	XX.	XIII.	
A	11 A.	" 19	369269000	6,933,000	12,380	XVIII.	XX.	
B	.....	.....	.....	.....	.....	XV.	.....	
C	.....	.....	.....	.....	.....	XII.	.....	
D	.....	.....	.....	.....	.....	XIII.	.....	
A	.....	.....	.....	.....	.....	XX.	.....	

In the purification of gas by sesquioxide of iron, either in conjunction with lime or without it, a marked saving is effected over the cost with lime alone. In the address of President Valon, before the '92 meeting of the British Gas Institute, he remarks[1] that "It may be presumed we have all, without exception advanced to the position that purification dependent upon oxide without a due proportion of lime is indefensible as being incomplete and extravagant." However this may be in Great Britain, in America, with the absence of hampering sulphur restrictions and with a less cost for enricher, many engineers find that oxide alone will amply suffice as their material in the dry purifiers; and so long as lime, if employed at all, is placed in separate vessels from the iron, the *revivification* of our oxide becomes the factor of importance and cost second only to that of the choice of materials themselves.

The methods now in vogue for this restoration to life of our fouled material show the full evolution of the process, for the systems first suggested have thriven equally with their more economical progeny. The revival by removal from the boxes and simple exposure to the atmosphere was followed by the system of introducing a small percentage of air before the gas reached the purifiers, thus reviving to some extent *in situ*.[2] Then came the endeavors to compensate for the presence of nitrogen by carbureting the air; and the use of pure oxygen has followed as the latest method of treating this phase in the elimination of impurities from our principal product. But as yet it is only in England that manufactured oxygen has been at all extensively adopted, and there its more usual employment is for systematically "fixing" the sulphur impurities removed by *lime*, that the low sulphur limit imposed may be attained without causing the nuisance which would otherwise, except with air, attend the opening of foul boxes.

The writer had the pleasure of being present at the 1889 meeting of the British Gas Institute in London, when in course of the discussion following Mr. W. A. Valon's paper on the application of oxygen to the purification of coal gas, Mr. Norton H. Humphrys, of Salisbury, called attention[3] to the paradoxical contrast between the activity of ½ per cent. of oxygen in 99½ per cent. of mixed gases, as stated in the paper, and his own results with ½ per cent. of pure oxygen from the air in 99½ per cent. of other gases, with the only difference that in his case 2 per cent. of these other gases was atmospheric nitrogen. Following him, Dr. Thorne suggested that the presence of moisture in the former case might be largely responsible for the greater activity of manufactured oxygen. This discussion furnished Mr. F. G. Dexter the text for his article[4] before the Gas Institute, in 1892, in which he advocated the introduction of exhaust steam just before the purifiers to supply the moisture necessary for revival *in situ* with air, and by which he avoided more than one-half the number of purifier changes previously necessary.

This promising suggestion has found favor on both sides of the water, and has already been adopted at a number of works. I quote by permission of Mr. Irvin Butterworth, General Manager, the results obtained by the Columbus Gas Light Company with this system. He writes, under date of August 8th, 1893:

"Previous to the 1st of April, when we admitted no steam, we emptied and refilled boxes as follows:

December, 1892.	8	Oxide contained in each box, 625 bushels.
January, 1893..	10	Gas made, 105,848,000 cubic feet.
February, " ..	8	
March, " ..	10	
	36	

"Since April 1st, with practically the same oxide, we emptied and refilled as follows:

April, 1893.....	1	Gas made, 63,167,000 cubic feet.
May, "	2	
June, "	0	
July, "	0	
	3	

"For the same months of last year, with better oxide, we emptied and refilled as follows:

April, 1892.....	7	Gas made, 56,441,000 cubic feet."
May, "	9	
June, "	3	
July, "	2	
	21	

It will be interesting to note, when the time comes, if Mr. Butterworth's results with the system for the four months commencing with December of the *coming* winter are proportionally better than his summer work, as was the case in Mr. Dexter's report.

At the Laclede Company's Station B, the Dexter process has been in active use since the latter part of May. Our boxes hold but 560 bushels each, and the gas has carried 1.6 per cent. of H_2S at the purifier inlet. In spite of these disadvantages, Set No. 1 ran from June 10th to August 15th without changing, having passed 23,542,000 feet in that time, and Set No. 2 has just been changed (August 28th), having run since June 7th, and purified 36,752,000 feet, or 65,628 cubic feet per bushel. Our experience with steam is as yet too brief for positive assertions, but Mr. Dexter's claims have so far been justified most satisfactorily.

The high temperatures of registration when steam is thus admitted cause the uncorrected meter readings to show some remarkable yields; but allowance for the excess of temperature above the normal, which in justice to the distribution department should be made anyway, brings the production to a reasonable figure.

1. London *Journal of Gas Lighting*, Vol. LIX., p. 1107.
2. Newbigging's "Handbook," 5th ed., pp. 135-6; Herring's "Construction of Gas Works," p. 201; and London *Journal of Gas Lighting*, Vol. LXI., p. 267, or AMERICAN GAS LIGHT JOURNAL, March 20, 1893, p. 406.
3. *The Gas World*, London, June 22d, 1889, p. 730.
4. London *Journal of Gas Lighting*, Vol. LIX., p. 1,171.

While the perfection of revivification *in situ* was being sought, the problem of minimizing expense when boxes *are* changed was likewise receiving attention. The experiments of Mr. Dexter in 1890[1] were upon the revival of oxide in an off-box with the cover in place, forcing air through under conditions of pressure and of intimate contact with the material as nearly as possible resembling those existing with gas in the working purifier. In an experiment on these lines conducted at the Laclede Company's Station A, with 10-inch continuous pressure of air within the box, a series of analyses of the issuing air showed it to have been almost completely deoxidized, having only from 1.3 per cent. to 2.5 per cent. of oxygen remaining, the latter quantity being found at the end of 34 hours, when the experiment was discontinued.

The principal drawback to the success of this system was the hardening of the oxide. That difficulty is in some measure overcome by the arrangement described by Mr. W. A. Wood in a paper before the New England Association,[2] which plan he attributes to Mr. W. A. Learned. The system is that of reviving oxide in an open box by drawing air downward through the material, and expelling it above the roof by means of a steam jet applied in a temporary extension of the outlet main.

Desiring to try a similar principle without the expense of installing the roof stacks, we arranged at the Laclede Company's Station B, St. Louis, to aspirate the air through our material by the force of a steam jet[3] entering the inlet elbow of the box and pointing upward, thus drawing air downward through the box outlet and forcing the steam and air upward through the material.[4] The outlet stand pipe was covered with an iron plate provided with a grooved opening fitted with a slide, by which the quantity of air admitted could be adjusted. The presence of steam may have retarded the revivification to some degree after the oxidizing began, but as it aided in raising the temperature and hastening the commencement of the action, probably the results attained were not wholly inferior to those of Mr. Wood. We were enabled to thus treat an average of nearly three beds out of every four which we opened during the ten months that the practice was followed, without appreciable decrease in the quantity passing between changes; or, in other words, to effect a saving of nearly 75 per cent. of the former cost for labor. This saving in labor might have been still further increased had we turned the material in the boxes as described by Mr. Wood; but in our case the passage of steam through the box so saturated the wooden trays (which are somewhat longer than the average) that they sagged considerably, and we preferred to remove the oxide and reverse the trays. The thorough pulverizing of the lumps was also so much easier and surer on the floor that it partially repaid for the labor in removing.

We found the system to be especially applicable where the space on reviving floors is limited, but where revival by admitting air during purification can be followed conveniently. This is particularly true of oxide carrying a moderate proportion of sulphur, for with our adaptation of the process an added difficulty was found in preventing ignition in the material in both extremes of condition as regarded sulphur, compared with that with oxide of equal freshness or age which had been revived on the floor. Ignition under these conditions is especially productive of the pungent odor peculiar to burning oxide, doubtless due to the fumes of both sulphur dioxide and pyroligneous acid, which once noted is ever after unmistakable, and frequently announces the firing of the material when no hint of this is otherwise discernible.

When the oxide requires reviving outside the box, a prime requisite is thus stated by Mr. J. T. Sheard:[5] "If complete and speedy revivification is to be ensured * * * the material should attain to such a temperature as will facilitate the ready expulsion of the water that has been formed in the purifier. * * * The * * * condition can generally be met by heaping up the sulphided oxide as it is taken out of the purifier, whereby, as revivification sets in, the heat produced, instead of being disseminated into the atmosphere, is utilized to raise the temperature of the whole mass." The oxide must then have plenty of dry air, supplied by frequent turnings over, and, if possible, exposure to that potent agent sunlight.

Too much care can scarcely be given to prevent the presence of tarry particles in the oxide, and to ensure that it is revived as thoroughly as possible before being replaced in the set. Since in most works removal from a box is six or eight times as costly as turning a bed over on the floor, it will pay to make doubly sure the precipitation of all sulphur contained and the complete re-conversion into oxide, so far as handling on the reviving floor can be made effective.

It is often asked what proportion of sulphur oxide will absorb before becoming unfit for use. The comprehensive reply to this question must consider the conditions, not alone of cost of new material, but also those of quantity of Fe_2O_3 in the mixture, percentage of H_2S in the gas to be treated, relative size of purifiers for the season in question, and quantity of comparatively fresh oxide on hand and of space for revival. So long as purification and revivification can be carried forward simultaneously, it will pay to continue the use of oxide which already contains a high proportion of sulphur. Thomas Newbigging[1] states that by the Hawkins process 75 per cent. may be reached, and Norton H. Humphrys speaks[2] of having used a bed until it contained 63 per cent. of sulphur; while instances of the attainment of 52 to 56 per cent. are by no means uncommon. But it may be stated, in general terms, that where it is impracticable to avoid handling the nearly spent material, aside from exceptional cases of cheap labor and dear oxide, it rarely pays to saturate with sulphur beyond 45 to 48 per cent.

Estimation of the contained sulphur is decidedly convenient in comparing with "feet per bushel" results in oxide of relatively brief exposure to H_2S, and is well nigh indispensable in determining the limit of usefulness. The test described by Mr. Newbigging[3] may be carried out at any gas works at little cost, the only expensive apparatus required being the delicate balance, the lack of which may be overcome by the use of the scales at the nearest drug store. An ordinary beaker half filled with water may be substituted for the condenser, and the vaporized bisulphide of carbon be led beneath the water by a straight tube instead of a coil; so cheapening the apparatus with no essential decrease in either accuracy or safety. Before the application of the bisulphide, all moisture must be driven off by drying at about 200° F., and the oxide must be thoroughly revived.

Our brethren across the Atlantic are able to recoup a large portion at least of the cost of new oxide by disposal of the spent for its contained sulphur. But I have yet to hear of any regular market for it in this country, owing largely to the cheapness of native pyrites. Experiments on a working scale were lately conducted at a large gas plant in a neighboring city, looking to the recovery of the cyanides, but without pecuniary success. In default of such an outlet for our spent oxide, about the only way of realizing anything for it is by burning it ourselves to recover the red oxide, which will be in the anhydrous state. This burning will often occur spontaneously in a dry heap, especially if exposed to the wind. For perhaps two-thirds of an average pile the sawdust and sulphur will provide sufficient combustible to keep the fire going, but it must have a large excess of air, and be protected from rain. Some of the sulphur may be sublimed and deposited on the surface of the heap, but the bulk of it will pass off as sulphur dioxide. When the red oxide is left as a crust upon the bed, it is removed for use, allowing air to reach the still unchanged mass below. Finally, drip oil may be used to burn out the last of the sulphur, or the oxide may be piled on an iron screen and fire applied below. From the necessity of securing an excess of air, and the tendency of the sulphur to fuse if heat is applied and this condition is neglected, I fear that the recovery of both iron and sulphur from a spent oxide is not likely to be accomplished unless a great reduction in the cost of carbon bisulphide permits the roasting process to be discarded.

Mr. A. H. Strecker, in a contribution to the proceedings of the Society of Gas Lighting,[4] recommends renovating spent copperas oxide by adding to it some 50 per cent. of its weight of fine iron borings. The arguments against handling oxide having a high proportion of sulphur apply with increased force to this plan. Undoubtedly the added iron will be nicely oxidized by the expedient, but the office of the old mass can be equally accomplished by coarse sawdust and a little salt, at considerably less weight.

Apropos of the employment of this mixture, there are in the manufacture of home made oxide advocates for both copperas ($FeSO_4,7H_2O$) and ordinary iron borings as bases for the purifying agent. The use of the former enables material to be made up quickly, but a high proportion of iron in the finished product is very difficult to attain, and the cost for iron is much greater. For consider that in green vitriol, whose price will range about $19 per ton, iron forms but one-fifth of the weight, while iron borings will be delivered at not exceeding $8 per ton, or at one-twelfth of the cost, iron for iron. And we have obtained borings this present season as low as $4 per ton delivered.

1. London *Journal of Gas Lighting*, Vol. LVII., p. 643.
2. American Gas Light Journal, March 21st, 1892, p. 398.
3. Compare King's "Treatise on Coal Gas," vol. ii., p. 18.
4. This will be best understood when it is remembered that within the center seal the inlet and outlet pipes of the off-box open together. The center seal diagram published as a supplement to Progressive Age, August 15th, 1889, will assist in showing this clearly. With boxes connected by a valve system, this particular arrangement would of course require modifying.
5. London *Journal of Gas Lighting*, Vol. LXI., p. 680.

1. Handbook, 5th Edition, p. 136.
2. "History of a Heap of Oxide," London *Gas World*, June 22, 1889, p. 738.
3. Handbook, 5th Edition, pp. 378-9.
4. Society of Gas Lighting, Proceedings of 1889. p. 90.

So high an authority as Mr. Thos. Newbigging may be quoted as suggesting[1] that the intensity of heating of new oxide on first coming out of the purifier may be modified by mixing with it a portion of that which has become partially spent—a suggestion which the writer does not favor. Such added material will soonest become inert, and will make it more difficult to credit a bed with results that properly belong to it. The trouble from fresh oxide may be avoided by careful attention and immediate removal from the foul box, and after one or two exposures the probability to ignition becomes greatly reduced. In his Monograph on Oxide of Iron, Mr. John T. Sheard makes these recommendations:[2] "To moderate the excessive activity of new oxide, it should be used at first in very thin layers only; and the fouled oxide should be well watered, immediately on opening the purifier, before removal."

Another expedient sometimes adopted is that of mixing slacked lime with partially spent oxide, with the object of increasing the activity of the latter. Since the sluggishness in reviving of such oxide when free from tar is due to the inert sulphur contained, it is difficult to see how this object can be thus effected. The lime is of course active for H_2S and CO_2 until carbonated, but is then of no more efficacy than any other lightening material, while in its pastiness it is apt to enclose some iron particles and prevent their further sulphiding or oxidizing.

Another custom, that of "Changing on the million" or the equivalent practice, opening boxes when a predetermined quantity of gas has passed, seems with oxide to be of mistaken advantage; since the conditions of purifying power of the several beds or of the same bed at different times, of gas made per day, and of impurity to be dealt with, are seldom wholly duplicated.

It is sometimes said that those who know anything about oxide know *all* that has been established concerning it; but I would strongly voice the opposite opinion, and instance the numerous works where the results obtained are but 25 per cent. or less of those which might be reached by adapting some one of the inexpensive systems to which reference has been made, other conditions remaining unaltered. But in considering and comparing results with these processes, no one who has ever noticed the improvement in summer working over the results of the previous winter, will overlook the important factor of speed in passage of gas during purification, or in other words of purifying area. For instance, the "banner run" of the Laclede plants was at their Station A, when the No. Three Set was in operation from Oct. 26th, 1892, to May 8th, 1893, having passed 123,155,000 cubic feet, and was then changed on account of causing back pressure, and not because of having fouled. The boxes contain 1,000 bushels each, and are connected by a valve system which enables all four to be in use at once. About 1¼ per cent. of air was admitted with the gas, but no further agency can be credited with this long run except the ample size of the boxes.

That there is a paying field for intelligent research still unexplored, and much yet to be learned about the processes in present use, no one will deny; but all have by no means availed themselves of the systems already demonstrated successful. To direct attention to some of these possibilities in oxide purification has been the object of this contribution, and it is hoped that by the use of some of the processes indicated other superintendents may be enabled to reach the point already attained by those in whose works the costs of purifying are included in the account of manufacturing expense, as purification has become too small an item to be separated.

The President—It is thought best, as there are three papers upon oxide purification, to have them all read before the discussion is entered upon, and then have them all discussed together. This will save a great deal of time, and the discussion can be made more general. As President of the Association I thank you, Mr. Thompson, in behalf of the Association, for this very creditable paper.

Committee on Next Place of Meeting.

The President—It is necessary to appoint a committee to select the place for our next meeting. If there is no objection I will now name that committee, and will ask them to sit during the recess, and, if possible, fix upon a place and report this afternoon. I will appoint on that committee Messrs. Irvin Butterworth, Columbus, O.; A. C. Humphreys, Philadelphia, Pa.; I. C. Baxter, Detroit, Mich.; George S. Hookey, Augusta, Ga., and David H. Geggie, of Quebec. The hour for lunch has arrived, and we will take our recess. I will request the members to convene again promptly at half-past 1, and I hope to see as many as possible present to listen to the very interesting papers and to take part in the discussions.

The Association then took a recess until 1:30 P.M.

1. Handbook, 5th Edition. p. 132.
2. London *Journal of Gas Lighting*, Vol. LXI., p. 634.

First Day—Afternoon Session.

The Association reconvened at 1:30 P. M.

Report of Committee on President's Address.

Mr. Pearson submitted the following report from the Committee on President's Address:

The Committee on President's Address beg to report as follows:

First. With regard to the suggestion for a federation of the various Associations of the country, we are not prepared to recommend the adoption of this at once, but suggest that a committee be appointed to consider and investigate the matter and report at the next meeting of the Council of the Association.

Second. The Committee would recommend to the careful consideration of the members the very valuable suggestions in the address with regard to the more extensive utilization of gas as a heating agent and for motive power, and also the adoption of the latest and best improvements in gas burners and apparatus.

Third. The Committee are much impressed with the statement as to the peril in which properties of gas companies are placed by the attempts on the part of municipalities to take possession of them at a price which practically amounts to confiscation, and would recommend the members to thoroughly post themselves in order to take the most effectual measures to prevent the carrying out of such attempts.

W. H. Pearson,
E. H. Jenkins,
B. E. Chollar,
} Committee.

The President—You have heard the report of the Committee. What is your pleasure in the matter? Will you adopt the report and have it placed on your minutes?

Mr. Littlehales—I move the adoption of the report.

The President—It is moved and seconded that the report of the Committee be adopted and spread upon the minutes. (Adopted.)

Mr. J. A. P. Crisfield, of Savannah, Ga., read his paper on the

RATE OF PURIFICATION.

This subject, we believe, occupies the attention of the Association more or less closely at all of its meetings; but it has not been presented in such shape that in the resultant discussion there has been established a reliable conclusion that may be accepted by one and all as a guide to economical management of the purification department of a gas plant. The published records of the Association show plainly that we have recognized the value of large boxes, or low rates of purification; indeed, so strongly has this conviction seized upon us, that at this date the only limit to size of purifier boxes seems to be the financial condition of the company contemplating extensions, and ground space. We know of one superintendent who has not changed his purifier boxes during twelve months. It is quite evident, with the now almost general use of iron oxide, and the growing practice of revivification *in situ*, that labor, the element of cost of purification we are seeking to decrease by larger boxes, is becoming comparatively small. On the other hand, interest upon capital invested increases with the size of the box. The gas manager is in business to earn dividends, and he has earned the largest dividends upon capital invested in a purification plant when the charges for labor and the amount of capital are at a minimum.

It is our endeavor here to indicate how much weight should be given each of the mutually dependent elements, capital and labor, so that their combined cost for interest and wages may be a minimum.

With this purpose in view we carried out a series of experiments with four boxes, capacity of each, 80 cubic feet of iron sponge, weighing 60 pounds per cubic foot, containing 15 per cent. free sulphur. Carbureted water gas of 28 candle power was purified through these boxes at various rates, with the results shown in Table I. By actual experiment we found that with the above oxide, which appeared to the eye like coarse sugar, the volume of interstices or passages for gas through it was 33⅓ per cent., nearly, of its total volume; consequently the 240 cubic feet held by three of the above boxes could still accommodate 80 cubic feet of foul gas. Hence, knowing the volume of oxide between the inlet to the purifiers and the point of testing for H_2S (in this case the outlet of the third box), and the rate per hour by meter, we can easily calculate the time of contact between a unit of volume of foul gas and oxide.

The relation between these three quantities is expressed by:

$$\text{A.} \quad T = \frac{3{,}600\ V}{3\ R}$$

T (time of contact, in seconds = (volume of oxide between inlet and testing point) (rate per hour by meter).

Given any two of these quantities, the third may be found by solving equation A.

In column 1, Table I., are found the various rates per hour selected

in the experiment; column 2, resultant duty per cubic foot of oxide used; column 3, time of contact calculated from equation A. Note that with but 32 seconds contact, the oxide did no work at all, the foul gas passing through unchanged.

Throughout the experiment, which extended over three months' time, the boxes were emptied and refilled by hand, costing 2 cents per cubic foot of material handled. Therefore, the cost for labor per 1,000 feet of purified gas is expressed by dividing 2 cents by the duty per cubic foot. Let us now assume a yearly make of 175,000,000 cubic feet, or an average rate of purification per hour of 20,000 cubic feet, varying the sizes of the boxes in order to obtain the different values of T shown in column 3 of Table I. Assuming a depth of oxide of 2 feet in each of three boxes, and substituting above values for "T" in equation A, making "R" constant at 20,000, we obtain column 2 of Table II. In column 3 are the costs of these boxes; column 4, one year's interest at 10 per cent.; column 5, same interest per 1,000 for a make of 175,000,000 cubic feet; column 6, labor of handling material per 1,000 feet; column 7, total cost per 1,000 feet for interest and labor.

Running the eye down column 7 we see that the total cost is at a minimum when T is 48 seconds. Substituting 48 for "T" in equation "A," we have:

$$\text{B.} \quad 48 = \frac{3{,}600\ \text{V.}}{3\ \text{R.}}$$

With the practice of testing upon the second box, with revivification *in situ* and heavy sponge, labor's proportion of cost of purification would almost disappear in comparison with that of interest, and in the future we must look for economy in the purification plant from decrease in its size, though the problem of back pressure and the limit of 32 seconds contact determine how far we may go in that direction.

The situation demands purification with one box instead of four, and we expect to see such a plant in use in the near future. It may be objected that all iron sponge is not the same in duty, and the conclusion here reached is not general, but even with oxide only one-half as efficient as the above, the greatest economy would be obtained with a contact of one minute roughly.

As a thumb rule for the most economical sizes of boxes, we submit the equation C:

$$\text{C.} \quad 60 = \frac{3{,}600\ \text{V.}}{3\ \text{R.}}$$

Where "V" is the volume of oxide between inlet of first box and point of testing gas, and R is the rate per hour. By substitution of the desired rate per hour V becomes known; divide V by 2 or 3, dependent upon whether it is the intention to test on second or third box, and the result is the volume of one box, which may be put into any length, breadth or depth that is convenient.

Equation C may be simplified for convenience to read:

$$\text{D.} \quad \text{R} = 20\,\text{V.}$$

Or the volume of oxide between the inlet to purifiers and the point of testing for H_2S should be 1-20th of the rate per hour.

TABLE I.—*Values of T and Duties per Cubic Foot Obtained by Experiment.*

1. Rate per Hour.	2. Duty of Cu. Ft. of Oxide.	3. Time of Contact.
3,000	24,000	96 seconds.
4,000	22,000	72 "
5,000	19,000	57 "
6,000	16,000	48 "
7,000	8,000	41 "
8,000	4,000	36 "
9,000		32 "

TABLE II.—*Cost per* 1,000 *Cubic Feet for Interest on Plant at* 10 *Per Cent.; Labor of Handling Materials,* 2 *Cents per Cubic Foot. Yearly Make,* 170,000,000 *Cubic Feet.*

1. T.	2. Four Boxes 2 Ft. Deep.	3. Cost with Building.	4. Interest at 10 Per Ct.	5. Inerest per 1,000 Ft.	6. Labor 2c. Duty.	Total Cost.
96 sec.	16×16	$9,894	$989.40	$.0058	.0008	$.0066
72 "	14×14	8,232	823.20	.0043	.0009	.0052
57 "	12×13	6,864	686.40	.0040	.0010	.0050
48 "	11×12	6,000	600.00	.0035	.0012	.0047
41 "	10×12	5,753	575.30	.0034	.0025	.0059
36 "	10×10	4,800	480.00	.0028	.0050	.0078

The President—The question of purification is taken up in three papers, and we will discuss this in connection with the other two. As President of the Association I tender you, Mr. Crisfield, the thanks of the Association for this very valuable paper. It is the more valuable from the practical results which are obtained and the simple rules for arriving at the proper size of boxes and rate of purification, as they are laid out and approved by the tests which Mr. Crisfield has gone to such trouble to explain.

REPORT OF COMMITTEE ON NEXT PLACE FOR MEETING.

The President—If the Committee on Place for Next Meeting are ready to report we will now hear from them.

Mr. Butterworth—The Committee were unable to see one of our members. Four of the Committee have, however, taken the matter into consideration, and have arrived at a unanimous conclusion, so they would have outvoted the other member if he should not happen to agree with us. We are unanimously in favor of Washington, D. C., for the next place of meeting, and so recommend.

The President—Your Committee report and recommend that the next meeting of this Association be held in Washington, D. C. Are you ready for the question? Will you accept the report?

Mr. Floyd—Before taking a vote on that, I would like to inquire whether the Constitution does not say that we shall go to New York every third year?

The President—It does not.

Mr. Littlehales—I think it is one of the unwritten laws, ratified by the practice of the Association, that we shall meet in New York at least once in three years; and I think that would be a very good rule to follow, as most people like to see New York at least once in two or three years. I think that has been the rule, and I think it is one that it would be well to adhere to.

Mr. Somerville—I would like to indorse the Committee, as they say they were unanimously in favor of Washington, but I would like to ask for the reasons which influenced the minds of the members of that Committee in choosing Washington. It may be that something has influenced the Committee that we do not know about. Will the Committee please explain what particular reason they have for choosing Washington?

The President—Mr. Butterworth, can you explain?

Mr. Butterworth—I should probably have added that we drafted the next President of the Association in as a sort of additional committeeman and consulted with him, and he agreed with us very strongly in the suggestion that Washington would be a good place. We did not really canvas the merits of different cities particularly. We talked of a northern city, and we talked of a city in Canada, but agreed that October would be rather too cold a month to meet in the latter place, and as we had met so frequently in New York, and had not met in Washington for 10 years (next year will be the 10th year), we thought that Washington would be a good place to meet in, and so we united in recommending it.

The President—Are you ready for the question upon the adoption of the report by your Committee? All in favor of the adoption of the report will signify it by saying Aye; contrary minded, No. It is carried; the city of Washington will be the next place of meeting. The next paper to be read before the Association is that on the "Relation of Temperature to Purification," by Mr. James Somerville, of Indianapolis. These papers having been mailed to the members, will not be distributed in the meeting. I wish to state in this connection that the papers were received by the Secretary too late to be mailed to the residences of long-distance members, such as those living west of Chicago, and in the South, and fearing that they might not receive their copies if mailed, they were brought here for distribution to those members, and they will receive them upon application to the Secretary.

Mr. Somerville then read his paper entitled

RELATION OF TEMPERATURE TO PURIFICATION.

I have found by experience that the purifying material lime and oxide of iron at a certain temperature fails to thoroughly purify the gas. My attention was especially called to this fact during the intense cold of last winter.

I was requested by a gas company to investigate the cause of this source of trouble. The complaint was the loss of illuminating power, the stoppage of burners and the odor of foul gas in the houses. They were making coal gas, and purifying entirely with lime. On applying the usual tests for impurities at the test cocks on the covers I found no trace of sulphureted hydrogen; the test showed clean gas. It was this fact which puzzled the managers. Yet on raising the temperature of the purifying material the trouble entirely disappeared. The lime had become inert by reason of the low temperature, which was at 32° F., and allowed a portion of the gas to pass unpurified.

The impurities in the gas were also inert at this temperature, which was the reason they gave no sign of their presence; but as the tempera-

ture increased on their approach to the consumers' burners their activity became apparent, with the results as stated.

I have also found water gas, with oxide of iron as the purifying material, affected in precisely the same manner and giving the same results, if anything in a more intensified form. Being desirous to ascertain, by varying the temperature of the purifying material, if the gas would reveal any symptoms of such change of temperature, I had the following analyses made.

The coal gas analyzed was of 17-candle power without any enricher. The water gas was 19 candle power. The oxide and lime used in the experiments were taken from the shed; no alteration was made from everyday working conditions. Each kind of gas was stored in a small holder, and all the samples were taken from it. The crude gas was taken into the holder from the inlet to the purifiers. The temperature of the crude gas was 70° F. We tested each sample of gas for sulphureted hydrogen after it had passed through the experimental purifier; all the tests showed perfectly clean, except when the water gas was passing through oxide of iron at 32° F. the test showed decided traces of sulphureted hydrogen, indicating plainly that the oxide was not purifying the gas at that temperature.

Coal Gas. Purifying Material, Lime. Temp., 102 Deg. F.		Coal Gas. Purifying Material, Oxide of Iron, Temp., 108 Deg. F.	
Carbonic acid (CO_2)	trace.	2.00	per cent.
Olefiant gas (C_2H_4)	4.00 per cent.	4.00	"
Oxygen (O)	1.00 "	1.00	"
Carbonic oxide (CO)	8.00 "	8.00	"
Hydrogen (H)	41.32 "	44.00	"
Marsh gas (CH_4)	38.00 "	38.00	"
Nitrogen (N) & water vapor	7.68 "	3.00	"
	100.00	100.00	

Temp., 70 Deg. F.		Temp., 71 Deg. F.	
CO_2	trace.	2.00	per cent.
C_2H_4	4.00 "	4.00	"
O	1.00 "	1.00	"
CO	8.00 "	8.00	"
H	42.66 "	45.32	"
CH_4	38.00 "	38.00	"
N and water vapor	6.34 "	1.68	"
	100.00	100.00	

Lime. Temp., 50 Deg. F.		Oxide of Iron. Temp., 49 Deg. F.	
CO_2	trace.	2.00	per cent.
C_2H_4	4.00 per cent.	4.00	"
O	1.00 "	1.00	"
CO	8.00 "	8.00	"
H	45.32 "	44.00	"
CH_4	36.00 "	38.00	"
N and water vapor	5.68 "	3.00	"
	100.00	100.00	

Temp. 32 Deg. F.		Temp. 32 Deg. F.	
CO_2	trace.	2.00	per cent.
C_2H_4	4.00 per cent.	4.00	"
O	1.00 "	1.00	"
CO	8.00 "	8.00	"
H	44.66 "	49.00	"
CH_4	36.00 "	36.00	"
N and water vapor	6.34 "	trace.	
	100.00	100.00	

Carbureted Water Gas. Purifying Material, Lime. Temp. 108 Deg. F.		Carbureted Water Gas. Purifying Material Oxide of Iron. Temp. 108 Deg. F.	
Carbonic acid (CO_2)	trace.	3.00	per cent.
Olefiant gas (C_2H_4)	17.00 per cent.	17.00	"
Oxygen (O)	trace "	0.50	"
Carbonic oxide (CO)	30.00 "	29.50	"
Hydrogen (H)	32.00 "	32.00	"
Marsh gas (CH_4)	14.00 "	14.00	"
Nitrogen (N) & water vapor	7.00 "	4.00	"
	100.00	100.00	

Temp. 70 Deg. F.		Temp. 72 Deg. F.	
CO_2	trace.	3.00	per cent.
C_2H_4	17.00 per cent.	17.00	"
O	trace.	trace.	
CO	30.00 per cent.	30.00	per cent.
H	33.32 "	36.00	"
CH_4	14.00 "	14.00	"
N and water vapor	5.68 "	trace.	
	100.00	100.00	

Lime. Temp. 50 Deg. F.		Oxide of Iron. Temp. 50 Deg. F.	
CO_2	trace.	3.00	per cent.
C_2H_4	17.00 per cent.	17.00	"
O	trace.	trace.	
CO	30.00 per cent.	30.00	per cent.
H	36.00 "	36.00	"
CH_4	14.00 "	14.00	"
N and water vapor	3.00 "	trace.	
	100.00	100.00	

Temp. 32 Deg. F.		Temp. 32 Deg. F.	
CO_2	trace.	3.00	per cent.
C_2H_4	16.00 per cent.	17.00	"
O	trace.	trace.	
CO	30.00 per cent.	30.00	per cent.
H	34.66 "	33.32	"
CH_4	14.00 "	14.00	"
N and water vapor	5.34 "	2.68	"
	100.00	100.00	

Note—The gas in this analysis showed traces of sulphureted hydrogen after passing through the purifier.

I do not suppose that these analyses reveal anything new to you, nor do they to any great extent confirm my previous statement regarding the effects of a low temperature of the purifying material upon the gas, except as you will observe in the coal gas series at the temperature of 50° and 32° the marsh gas drops 2 per cent.; although marsh gas is non-luminous, yet it performs a most important function in bringing the olefiant gas into a state of incandescence. You will notice also that the olefines in the water gas at a temperature of 32° drop 1 per cent., and also that the oxide of iron failed to arrest the sulphur at the temperature. I think we may conclude, therefore, in view of these results, that it will be well for us to keep our purifying houses and purifying material up to a temperature of 60° F. during the winter months.

Discussion.

The President—You have heard a very interesting and instrucutive paper from Mr. Somerville, and in behalf of the Association I extend to him our sincere thanks for it. The three papers upon oxide purification having been read, they are now open for discussion.

Mr. Littlehales—I would like to ask Mr. Thompson, the reader of the first paper, if I correctly understood him as intimating that lime may be dispensed with to advantage in favor of oxide purification. It seemed to me that in reading the paper he took a somewhat different view from that laid down by Mr. Somerville, and I would like to get Mr. Thompson's answer to that question.

Mr. Thompson—I think Mr. Littlehales, on referring to the paper, will find that statement was made with a proviso—that, in the absence of hampering sulphur restrictions, and with a low cost of enricher, lime might be dispensed with to advantage.

Mr. Littlehales—Then I think Mr. Somerville has entirely disproved that position. If you will look on the table that Mr. Somerville has given you will notice he shows with lime there is a variation of from 2 to 3 or 4 per cent. of carbonic acid present. With my little knowledge of purification I confess I cannot understand how the carbonic acid is going to be disposed of if you dispense with the use of lime—unless you are previously washing the gas with a strong ammoniacal solution. That oxide of iron will not take up carbonic acid is a fact which is, I think, known to every one present. It has been laid down by the text books for the last 30 years that the presence of 1 per cent. of carbonic acid destroys something like 7 per cent. of illuminating power; and if you get 2 or 3 per cent. of carbonic acid in your gas it necessarily means an extra cost for the enricher, and it also means that if that carbonic acid is not taken out it makes too dense a gas. Therefore, I think that that statement by Mr. Thompson should not pass unquestioned. I would like to deal also with this question: Some are given to mixing lime with the oxide of iron. I cannot see what object they have in view in mixing the two together, because after lime has become carbonated it is so much inert material, and there is no advantage in putting it back again. Therefore I think that practice must be a mistake. I have not got the figures here of the results of five or six years' working of a system of oxide and lime purification—the lime first and the oxide second;

but I have found that for five years it has cost two-tenths of 1 cent per 1,000 feet. We have never changed more than six of the oxide purifiers in a year. No doubt that is largely due to the large size of the boxes and to the fact that the carbonic acid and ammonia are removed by efficient washing and scrubbing. The fact of the oxide taking fire quickly when taken out of the boxes is to my mind almost an evidence of the excellence of the oxide, as it indicates a rapid chemical action. For the last six years we have used nothing but natural oxide, and the result is as I have stated—that two tenths of 1 cent per 1,000 feet is the average cost of about six years' operation, and there is at least another year's life in the oxide.

Mr. Somerville—I wish to emphasize what Mr. Littlehales has called attention to about this thing of purification by oxide of iron. I do not know why my friend Mr. Thompson calls it "purification." I can tell him that the gas is not purified. Some gas will pass out containing 3 per cent. of that deadly poison, carbonic acid gas. I protest against it. We have no right to do it. What right have we to send out 3 per cent. of a deadly gas into the houses of our consumers, for the sake of saving a quarter of a cent or 12 cents per 1,000? I say that it is all wrong. I do not know that it takes away illuminating power, but I do believe that it hurts the consumer's meter. Carbonic acid is, of course, an acid, and as such it attacks all metals. I do not want the idea to go abroad from here that the gas managers of the country are engaged in any such business as sending carbonic acid gas into people's houses.

The President—Mr. Somerville, are you not a little in error in your remarks about carbonic acid gas? You have reference to carbonic oxide, have you not, as being a deadly gas?

Mr. Somerville—No, sir; I mean CO_2, carbonic acid.

Mr. Thompson—I would like to ask Mr. Somerville whether the effect of burning the carbonic oxide to carbonic acid, and so forming a very large percentage of carbonic acid, is going to be worse than the presence of 2 per cent. of carbonic acid in the gas as manufactured?

Mr. Somerville—You should not have it there. You have no right to send out carbonic acid gas to your consumers.

Mr. Thompson—In the experiments to which reference has been made of the introduction of exhaust steam during revivification for the purpose of supplying the moisture necessary for revival *in situ* with air, it has been contended that the office of the steam was not alone that of supplying moisture, but also of adding to the heat of the boxes, because of the temperature that would otherwise exist in the purifying boxes, and also of maintaining that temperature at which fusion of the sulphur would take place, and thereby preventing the making of any back pressure which might otherwise exist. That would apply to Mr. Somerville's remarks on the importance of maintaining high temperatures in purification.

Mr. Miller—Mr. Littlehales made a statement, which I think ought not to pass unquestioned—that the presence of 1 per cent. of carbonic acid would destroy the illuminating power to the extent of 7 per cent. I do not agree with him that that is unquestioned. I think it has been shown by experiments, the results of which have been brought before the Associations from time to time, that this is not the case—that 1 per cent. of carbonic acid will not destroy the illuminating power 7 per cent., and especially with high candle gas. If any one has experimented with that I think it would be well to bring it up at this point. I challenge that statement that 1 per cent. of carbonic acid will do it.

Mr. A. C. Humphreys—I would say that the old tables were to the effect that the lower candle power gas showed 6 per cent. impairment for the first 1 per cent. of carbonic acid. That might be true in the old days, with 12 to 14 candle power gas; but we know that it is absolutely incorrect with high candle gas. I think we all agree that carbonic acid will not have such a deleterious effect upon candle power as has been suggested. As Mr. Miller has said, the papers which have been brought forward from time to time in the Associations show that the old rules with regard to the effect of carbonic acid must be amended. I would also like to ask Mr. Littlehales if I understood him to say that there was no use in employing both lime and oxide together?

Mr. Littlehales—My point is this, that mixing the two masses together was a mistake, because when the lime has become carbonated it is then inert and you are simply moving along with an inert matter.

Mr. A. C. Humphreys—But as I understand it the oxide makers merely use that as an oxiding agent. That is the excuse they give to me for putting it in. As to its being inert, I suppose there is no question about that. I thought his point was with regard to the employment of oxide and lime together, in separate masses, however.

The President—If there is no further discussion we will pass to the reading of the next paper, that by Mr. Fred. B. Wheeler, of Mount Vernon, N. Y., on

MATHEMATICAL ANALYSIS APPLIED TO PHOTOMETRICAL OBSERVATIONS IN LEGAL CASES.

In a certain city a gas company had a long-time street lamp contract at a good price, but with a clause in the contract providing that "the gas furnished must average 20 candles." The city officials, on a pretext that the gas was not up to this standard, employed a so-called expert to make photometrical tests for two weeks. He made a number of tests daily for 12 consecutive days, and the respective daily averages herewith follow, paralleled by the readings of the gas company's superintendent for same days on same bar:

City.	V.	V_1^2.	Supt.	V_2.	V_2^2.
22.28	+2 56	6.5536	22.00	+1.25	1.5625
19.39	— .33	.1089	20.40	— .35	.1225
19.34	— .38	.1444	20.55	— .20	.0400
20 24	+ .52	.2704	20.15	— .60	.3600
21.69	+1.97	3.8809	20.30	— .45	.2025
19 91	+ .19	.0361	20.80	+ .05	.0025
17.92	—1.80	3.2400	20 95	+ .20	.0400
19.05	— .67	.4489	21.10	+ .35	.1225
18 56	—1.16	1.3456	20.60	— .15	.0225
19.28	— .44	.1936	20.75	± .00	.0000
19.39	— .33	.1089	20.80	+ .05	.0025
19.57	— .15	.0225	20.80	+ .05	.0025
Avge, 19.72	—0.02	16.3538	Avge, 20.76	+ .20	2.4800

A difference of 1.04 candles is seen at once, although the expert's average of readings is only 0.28 of a candle below the contract requirement.

The authorities considered they had proved their case, and notified the gas company of their intention of breaking the contract. Each side being sure they were right, after much argument the difficulty was referred to an eminent patent lawyer as referee. He submitted the observations to me for examination. I noticed that the first and fourth pairs of readings were close in their correspondences, and that the superintendent's readings were much less irregular in their variations than the other's. I decided to analyze them by the method of least squares. The result obtained, including the referee's decision in the gas company's favor, is the reason of this paper.

Subtracting each man's observations in turn from his average we obtain tables of residual errors, $V_1—V_2$, and tables of squares of these residuals, $V_1^2—V_2^2$, all of which we add. For perfect accuracy the algebraic sum of the residual errors $V_1—V_2$ should be zero.

The sum of the squares of these residuals is respectively

$$\sum V_1^2 = 16.3538$$

$$\sum V_2^2 = 2.48$$

In the theory of probabilities the values of weights of observations are to one another as the squares of the measures of precision, or inversely as the squares of the residual errors, provided the number of observations are equal in each case. Therefore the values of these two sets of observations are as $\sum V_2^2 : \sum V_1^2$, or as

$$\frac{2.48}{16.3538}$$

That is, if to the average obtained by the expert a weight or value of 2.48 be assigned, the gas superintendent's average is worth 16.3538.

Then, to find the most probable or best value of the candle power from these observations, use the formula

$$X = \frac{W_1M_1 + W_2M_2}{W_1 + W_2}$$

where W_1W_2 are the weights and M_1M_2 are the respective averages of the readings. Substituting the values above—

$$X = \frac{2.48 \times 19.72 + 16.3538 \times 20.76}{2.48 + 16.3538} = 20.62,$$

the most probable candle power of the gas as shown by comparison of the two sets of readings.

The probable mean error of the arithmetic mean, 20.76, is shown by formula

$$E = 0.6745 \sqrt{\frac{\sum V_2^2}{N(N-1)}}$$

where N equals number of observations.

Or $E = \pm 0.092$. Subtracting this from 20.76, we get 20.668, closely agreeing with best value 20.62 found above.

The analysis having shown from the residuals that the Superintendent's readings were probably more accurate by $\frac{16.3538}{2.48} = 6.6$ to 1 than

the city expert's, that, in consequence, the candle power was most probably 20.62 instead of 19.72, and that as the probable error of the superintendent's arithmetic mean was only ±0.092 of a candle, the referee decided the case in favor of the gas company.

Similar application to other cases of this method of discussing observations is obvious, as well as to making comparisons between the work of different men in a gas company.

The President—You have heard a very interesting paper, and it is the statement of a very novel way of finding the probable candle power, or the most accurate candle power, from various readings by various men. Are there any questions you wish to ask Mr. Wheeler? (Silence.) There seems to be perfect unanimity of opinion that Mr. Wheeler is absolutely right, and I therefore extend the thanks of the Association to you, Mr. Wheeler, for your very interesting paper.

[To be continued.]

Supplement to Instalment of Report Published in Last Issue.

The following documents were omitted from their regular order in the instalment of proceedings printed in our issue for October 30th:

APPLICATIONS FOR AND ELECTION TO MEMBERSHIP.

CHICAGO, ILLS., Oct. 18th, 1893.

To the Members of the American Gas Light Association—Gentlemen: The Council have approved the following applications for membership and submit them to the Association with the recommendation that they receive favorable action:

Active.

Blood, Frederick C., Superintendent of Ware Gas Light Company, Ware, Mass.

Cardell, J. H., Superintendent of Memphis Gas Company, Memphis, Tenn.

Dunbar, Carl H., Inspector of American Gas Company, 222 South Third street, Philadelphia, Pa.

Gibbons, F. H., Superintendent of West Chester Gas Company, West Chester, Pa.

Harrison, George W., President Ashland Lighting and Street Railway Company, Ashland, Wis.

Logan, John D., Vice-President of Greenpoint Gas Light Company, Commercial street, Brooklyn, E. D., N. Y.

Page, Carter H., Jr., Engineer of Gate City Gas Light Company, Atlanta, Ga. (813 Drexel Building, Philadelphia, Pa.)

Rathell, Walter S., Superintendent of Works and Mains, Cairo City Gas Company, Cairo, Ill.

Westcott, J. T., Consulting Engineer for Belleville Gas Company, 269 Front street East, Toronto, Canada.

Wheeler, Fred. B., Superintendent of East Chester Gas Light Company, Mt. Vernon, N. Y.

Williamson, John, Assistant Engineer of Chicago Gas Light and Coke Company, 2 East Madison street, Chicago, Ills.

Associate.

Barrett, S. E., President of S. E. Barrett Mfg. Company, 70 La Salle street, Chicago, Ills.

Bingham, S. H., Secretary of S. E. Barrett Mfg. Company, 70 La Salle street, Chicago, Ills.

Curley, Edward J., Assistant Superintendent of Wilmington Coal Gas Company, Wilmington, Del.

Meyer, Hermann H. B., Designing Engineer James R. Floyd & Sons, 539 W. 20th street, New York, N. Y.

Scheel, Henry C., Wholesale Coal, Washington Building, 1 Broadway, Rooms 127-8, New York, N. Y.

Whitehead, John, Salesman for Luther & Lederhos, 30 Cliff street, New York, N. Y.

Number of Applicants—Active	11
" " Associate	6
Total	17

Respectfully submitted by the Council.

A. B. SLATER, JR., Secretary.

REPORT OF TREASURER FOR YEAR ENDING SEPT. 30TH, 1893.

Receipts.

Dues for year 1892	$40 00	
" 1893	1,570 00	
" 1894	35 00	
		$1,645 00
Initiation fees, Members elected Oct. 18, '92		390 00
Sale of proceedings		88 00
Sale of badge (to replace one lost)		3 70
Reports of 20th Annual Meeting:		
AMERICAN GAS LIGHT JOURNAL	$67 33	
Progressive Age	67 33	
Light, Heat and Power	67 33	
		$201 99
Interest on bank deposit		16 90
Total receipts		$2,345 59
Cash from last year		839 40
Total		$3,184 99

Expenditures.

Report of 20th Annual Meeting	$202 00	
Expenses " "	1 77	
Papers for " "	54 40	
		$258 17
Membership list		39 00
Volume 9, publishing	$1,190 00	
" distributing	102 11	
		$1,292 20
Duty on books from England		1 55
Expenses of Council Meeting, May 18, 1893		69 75
Stationery		6 69
Telegrams		9 57
Stamps and stamped envelopes		58 45
Part of Secretary's expenses to New York on Association's business, Sept. 21, 1893		19 55
Printing, circulars, cards, etc		38 00
Papers for 21st Annual Meeting:		
Electrotypes for illustrating	$25 40	
Expressage	3 30	
		$28 70
Salary of Secretary and Treasurer, including balance due from last year		650 00
		$2,471 63
Cash to carry to next year		713 36
Total		$3,184 99
Due from members:		
For year ending Sept. 30, 1891	$50 00	
" " " 1892	105 00	
" " " 1893	430 00	
		$585 00
Due from Wm. E. McKay:		
Bill of Nov. 7, 1893, complete set of proceedings		14 25
Total bills receivable		$599 25

There are at this date no bills payable.

Respectfully submitted.

A. B. SLATER, JR., Treasurer.

Examined and found correct, Chicago, Ills., Oct. 17, 1893.

C. J. R. HUMPHREYS,
E. G. COWDERY,
A. W. LITTLETON,
} Finance Committee.

REPORT OF SECRETARY FOR YEAR ENDING SEPT. 30, 1893.

Roll.—Honorary Members.

Published list of 1892		5
No change during the year; now on roll		5

Active.

Published list of 1892 shows		376
Elected October, 1892		22
Transferred, October, 1892		1
Renewed		1
Failed to qualify	1	
Dropped	7	
Died	8	
Resigned	7	
	23 from 400 =	377

Associate.

Published list of 1893 shows		30
Elected October, 1893		20
Failed to Qualify	2	
Transferred	1	
Resigned	1	
	4 from 50 =	46
Total now on roll		428

Members Deceased During the Year.

Geo. A. McIlhenny	Washington, D. C.	Oct. 16, 1892
John J. Griffin	Philadelphia, Pa.	Oct. 22, 1892
Austin M. Copp	Boston, Mass	Nov. 1, 1892
F. H. Odiorne	Boston, Mass	Jan. 3, 1893
Matt. Cartwright	Rochester, N. Y.	Apr. 25, 1893
Henry C. Hordley	Cumberland, Md	May 5, 1893
Edward Jones	South Boston, Mass.	Aug. 1, 1893
Not before recorded—		
Geo. W. Kraft	Philadelphia, Pa	Dec. 22, 1890

Members Resigned.

Active—		
W. H. Denniston	Pittsburgh, Pa	Oct. 5, 1892
C. E. Hequembourg	Dunkirk, N. Y.	Sept. 30, 1893
Malcolm Peters	New York City	Feb. 4, 1893
E. R. Phelps	White Plains, N. Y.	Oct. 5, 1892
W. D. Tilden	New York City	Sept. 30, 1892
Louis Wagner	Philadelphia, Pa	Aug. 22, 1893
H. K. Wilcox	Middletown, N. Y.	Aug. 16, 1893
Associate—		
W. E. Steen	Philadelphia, Pa	July 28, 1892

Respectfully submitted,

A. B. SLATER, JR., Secretary.

PROVIDENCE, R. I., Sept. 30, 1893.

The Ohio Mine Inspector's Report.

Something over a fortnight ago the Chief Inspector of Mines, Mr. Haseltine, filed with the Governor of Ohio the eighteenth annual report of the Department of Mines and Mining covering the year 1892. In presenting the report Mr. Haseltine explains that the delay in filing was due to the time usually devoted to the work having been occupied in collecting and installation of the State's mineral exhibit at the Columbian Exposition. After a review of the manner in which the State was redistricted and the changes in the department during the year made necessary by amendments to the mining law, the statistical portion is taken up from which the year's coal production is given as 14,599,908 tons, a gain of 1,549,721 tons as compared with the preceding year. In 10 counties the output exceeded 500,000 tons each. The counties of Athens, Hocking and Perry produced 37.7 per cent. of the entire output of the State. This shows a gain of 1.3 per cent. as compared with the preceding year. There were 21 mines in which coal was reclaimed by the use of mining machines, which were in operation an average of 188 days. To operate these employment was given to 344 machine men, and 2,301 men were employed in blasting down and loading the coal after it had been undermined. The tonnage produced from this source was 2,239,080 tons, an increase of 584,999 tons as compared with 1891.

The report shows that 20,658 pick miners were employed in the mines of the State, which is a loss of 79. The average time worked is given as 194 days, in which there was produced 12,360,728 tons of run of mine coal, which indicates an average of 598 tons 700 lbs. to each miner for the year's work, a gain of 33 tons 1,300 lbs. as compared with 1891. The number of day hands employed exclusive of tnose engaged in following mining machines is given as 3,669.

Ninety-one new mines were opened during the year. Sixty remained suspended, and 46 were either worked out or abandoned. At the close of the year there were 892 mines in the State; of these 832 were in operation the whole or part of the time. The daily average production of the mines was 75,257¼ tons, an increase of 3,041 tons as compared with 1891.

The table of inspections made shows that the mines were visited from one to eight times each during the year. The total number of visits made by the department is given as 1,625, an increase of 192 as compared with the preceding year. There were 86 sets of scales tested; of these 62 were found to be correct and 24 were inaccurate. Of the latter 8 favored the operator and 6 the miners. Under permanent improvements, 37 furnaces were built, 2 fire baskets hung, 26 fans installed, 65 air shafts sunk, 27 second openings were made. This is followed by a long list of general improvements.

Of the 434 large mines in the State, 91 are shafts, 40 slopes and 303 are drift openings. To ventilate these 127 fans, 253 furnaces and 11 fire baskets are used; 30 employ exhaust steam and 13 have natural ventilation. Thus 97 per cent. of the large mines of the State are ventilated by artificial means.

In a table exhibiting the number of tons of coal produced to the keg of powder consumed, it appears that in Hocking it was 107 tons, Athens and Perry 71½ and in Jackson but 31¼. These are the four largest producing counties in the State.

In 375 mines distributed over the State that produced 10,292,982 tons the average was 95½ tons. This is a new feature in the report of the department, and will be of interest to all engaged in the industry. The report contains an interesting article on the subject of oils used as an illuminant in the mines, which is followed by an article on the recent developments in the No. 7, or Cambridge coalfield.

In the fireclay industry the production was 1,253,110 tons, an amount in excess of any year in the State's history by 165,550 tons. To secure this output 675 miners were employed, and 3,751 hands were engaged in the manufacture of the various wares of which fireclay forms a component part. In the production of iron ore the report shows an increase of 21,738 tons, while the limestone industry indicates a loss in 7 of the 9 classifications under which it is prepared for the market.

The casualties during the year are given as 291; of these 42 resulted fatally, 93 were of a serious nature, and 156 were of minor character. Of the total accidents 43 per cent. were the result of falls of roof, 14 per cent. of falls of coal, and 25 per cent. were caused by mine cars. There were 347,929 tons of coal mined for each life lost, and 157,129 tons to each serious accident. While the coal production has exceeded that of any year in the State's history, no casualty had an unusual cause, and in no case has one occurred that could be classed as a "mining horror." The report is the most elaborate ever made by the department, and has many tables illustrating subjects of interest coming under its care, with minute details that show careful study of the subjects and knowledge of every branch of the industry.

Wasted Coal.

Mr. Walter J. May contributes to the *Am. Manufacturer* the following very interesting matter on the subject of wasted coal:

Some short time ago reference was made in these columns to the various coal dressing plants in Europe, and it appeared to be somewhat the opinion that this kind of thing is unnecessary in America. This the writer fails to see, and for the reasons which will presently be given. Coal may be taken to be used for four purposes, viz., household fires, forge, smithy and engine purposes, coke making and gas making; while anthracite and lignite are used for various purposes for which bituminous coals are more or less unsuitable. In every case, the cleaner the coal the better the value, and for this reason—that if we give, say, $5 for a ton of coal containing, say, 5 per cent. ash (all incombustible is classed as "ash") we really pay $4.75 for coal and 25 cents for ash; but if we give $5 for a ton of coal holding, say, 20 per cent. ash, we really pay $4 for coal and $1 for ash, besides the extra waste in labor in dealing with the waste, which really is a nuisance, both in the fire and out of it. Coke with a high percentage of ash is particularly objectionable, because the normal ash in coal does not exceed 5 per cent., as a rule, and more often is very much below this, the extra ash consisting of dirt which may contain a lot of insolubles, necessitating the use of fluxing material in the furnace, and thus causing an increase in the costs of working. Besides, the valuable element in coke is carbon, and if we get pure carbon we have the maximum of efficiency; but if we get instead of carbon a large percentage of foreign matters, we lose the units of carbon which are removed to make room for the waste, and in addition we lose a good many other units of carbon whose energy is absorbed in heating and calcining the ash, and the matters employed to flux the silica and other insolubles in the ash. Why, then, use dirty fuel?

The waste of coal in mines where bituminous coals are worked may well be taken to be 30 per cent. or more, and the waste represents an irrecoverable loss, not alone to the mine owner or operator, but to the nation at large; and although the coal in very few countries will be worked out for a few generations yet, it is rather advisable to look forward a little, as few people would like their successors to curse their memories.

The waste—which is largely preventable—arises from various causes, and amongst these come bad settings out of workings, the leaving of pillars to crush down, undue roof pressure caused by keeping the wood and pack walls too far back from the working face, the waste caused by employing careless or only partially skilled hewers, and by the mixing of dirt from the roof or floor in getting. Besides this, it often happens that only a certain percentage of slack is allowed to be sent out, and where this occurs, all above the allowed amount is thrown into the "gob," with the very frequent result that fires occur from time to time in mines working certain classes of coal, and these "gob fires" are often rather nasty things to deal with. In each and every case where coal is left behind for any reason, it is necessary to see whether the waste thus caused is a necessity, and if not, steps should be taken to prevent it. In every case all coal broken down should be brought to bank, and that which is too dirty should be washed, as the whole of the costs in connection with this work should not exceed 6 cents per ton.

Coal being raised exclusively for coking should be reduced to an even condition of fineness in a proper disintegrator if not washed, as this disseminates the ash equally throughout the mass of coke, giving it a better grain, and also reduces the amount of breeze, but where the dirt or ash is excessive, of course cleaning or grading must be had resort to before grinding. If we take an ordinary bituminous coal as it is broken down, it will be found that from 20 per cent. to 40 per cent. is slack—*i. e.*, under 1½ inches—and that this contains the waste or ash. It therefore follows that if the whole body of the coal be ground and mixed, the coke will have an even texture and analysis, and that the ash will be evenly distributed throughout, although probably there will be too great a percentage. Grinding, which is not a very costly matter, is always desirable where the whole output of the mine is used for coking, owing to the more level quality of the coke produced, but in many districts the "run of mine" is used quite irrespective of the quality of the coke.

Where pyrites or intercalated stone or other material exists in quantity, it is necessary to have coal cleaned before sale, and this can only be cheaply carried out by the wet processes which have been previously described in the *American Manufacturer* of recent dates. It, however, will often be found that seams of poor coal can be profitably worked when they are subjected to washing, and thus waste in this direction can be avoided.

In the case of the anthracite which is now wasted in the form of fine or slack, there really appears to be little reason why it should not be placed to practical use for many purposes. From experiments made by the writer with crushed anthracite, the most economical method of treatment would appear to be to use clay as an agglutinant, and to very thoroughly mix the coal and clay together, molding into balls of about 3 inches diameter, and drying before use. By using a sufficiently sticky clay, and thoroughly kneading it with the slack, only in such proportions as will cause the balls to be sufficiently firm and hard to travel well, a good fuel is produced which would in a fairly strong draught give off intense heat, but of course these would not be suitable for blast furnace work. With very simple plant this kind of fuel should be produced at a low cost, and should, if properly introduced, give a good financial result. The more adhesive the clay, the less would be needed to bind the slack, as a matter of course; and probably if well pressed into very small—comparatively—blocks, the slack would do well in ordinary domestic slow-combustion stoves. Pitch and similar agglutinants could not be very well used with anthracite, but the question of agglutinants could well be made the subject of some exhaustive experiments.

Taken altogether, the waste of fuel is a matter to be very seriously considered, and there is no insuperable difficulty in its prevention, while if there is no waste, it naturally follows that cost would be reduced. Of course, any reduction in price means an increase in consumption, and trade usually improves somewhat by the lessening of cost of any prime factor in producing any article, subject, of course, to financial crises, and fluctuations must always be expected to arise from time to time, as such appear to be irremediable under the present system of things.

THE proprietors of the Oakland (Cal.) Gas Light and Heat Company propose to donate to the city all the lands owned by them within the lines of Jefferson and Grove streets, extended from the southerly line of First street to the Peralta line, as soon as the title to the water front, now in controversy, is decided by the courts to be vested in the city. The effect of this donation will be to insure the opening of Jefferson and Grove streets to the water front without cost to the city, all conditional upon the latter establishing its title.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Lowe Gas and Electric Company, of Colorado Springs, Colorado, has been placed in the hands of a receiver, Mr. Irving Hawbett having been appointed to act in that capacity. The ruling cause is reported to have been important losses that resulted from the operation of the electric lighting division of the Company's business, mainly on account of cut rates for service in competition with another local electrical enterprise.

GOVERNOR RUSSELL, of Massachusetts, has nominated Col. John T. Wheelwright, of Boston, to the vacancy on the Board of Gas and Electric Light Commissioners occasioned by the resignation of the Hon. James W. McDonald. Col. Wheelwright, who was born in Roxbury, Mass., in 1855, is a graduate of the Harvard Law School, Class of 1878, is a noted club man of Boston, and is something of a literary man.

WORCESTER, MASS., Oct. 26, 1892.

To the Editor AMERICAN GAS LIGHT JOURNAL: Will you kindly allow me space in your columns to explain the enclosed circular, which a short time ago I sent to each member of the New England Association of Gas Engineers. This Association, as is well known, was the first one started in this country. It has prospered exceedingly and is now in thriving condition; but many of the members who were forward in the early days of the Association have practically withdrawn from active life, leaving the work to be done by the younger men. Not a few have died. It has seemed to me very proper and desirable that some start should be made towards a personal record of the members, and it also seems well to undertake the work now, while the necessary facts are obtainable. If the project is acceptable to the members of the Association and general response is made, I shall continue to collect and file data. I suppose that some time the collection will become the property of the Association. At present I shall carefully file all the statistics entrusted to me. *None of them will be published at any time.*—Very truly yours, CHARLES D. LAMSON.

THE circular by Mr. Lamson is appended:

WORCESTER, MASS., Sept. 23, 1893.

To———, Dear Sir: I am collecting statistics of the New England Association of Gas Engineers, and would like, if possible, to obtain a photograph of every member of the Association. Can you send me a picture of yourself of recent date, and if possible a picture taken about the time you became a member. I should like also the following memoranda: The year in which you were born; the year in which you became a member of the Association; the position you occupied at that time; the various positions you have held since, and your position and address at present time. If you can aid me in obtaining any of the above information in regard to any deceased member I shall be greatly obliged. —Yours truly, CHAS. D. LAMSON.

SPEAKING for ourselves, we hope that Mr. Lamson's queries will meet with quick and full response, for a collection of the matter desired by him will be of undoubted value and interest to the Association. The authentic record of the life's work of those who struggled to advance gas interests in the early days is history of the undeniable sort, which will serve to show to their successors how success is achieved.

AT the annual meeting of the Consolidated Gas Company, of Denver, Col., the only change made in the executive management was the election of Mr. H. M. Porter to the positions of Director and Secretary, replacing Mr. F. P. McManus in both offices.

THE New York Knife Company, of Walden, N.Y., is building a new fireproof storehouse, to be 28 feet in width and 100 feet in length. The side walls are to be of brick and the roof of iron, designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn., and the covering material is to be of the Company's well known anti-condensation corrugated iron.

CHAIRMAN HEARD, of the House District Committee, in charge of matters connected with the local government of Washington, D. C., has taken the first step toward the investigation of the gas supply of that city. He proposes to commence by gathering statistics and information covering the municipal lighting of the principal cities for purposes of local application. Following this course, letters were sent on October 24th to the Mayors of 60 cities, asking for answers to the following questions: By what system or systems is your city lighted? If by gas, what

kind of gas is mainly used? What is its strength per candle power test? What is the price of gas per 1,000 feet to consumers? What is the cost of gas coal delivered? What is the method of gas inspection? How many gas companies have you? Have you electric light plants? If so, how many? Under the terms of the Oathwaite resolution by which the investigation is to be made the report need not be presented for three months. The Chairman has not yet decided upon the form which the investigation will take, but under the terms of the resolution the Committee is given wide scope in the matter of its inquiries and recommendations.

A MOVEMENT is on foot for the erection of a gas works at Eldon, Ia., the estimated cost of which is returned at $30,000. This place is in Wapello county, Iowa, at a point on the Des Moines river where that stream is crossed by the Chicago, Rock Island and Pacific Railroad. It is 12 miles southeast of Ottumwa. Good coal is found in the vicinity, and the population of the place numbers about 6,000.

FLAMES, caused by the breaking of a naphtha pipe from the pump to the generator burst out in the plant of the Spencer (Mass.) Gas Company on the morning of Oct. 27th. The flames spread rapidly, their advance being the more rapid because of some derangement in the water supply of the works, which comes from a source known as Shaw's pond. The fire, however, did not spread to the oil tanks, and in an hour was under control. The loss is put at $1,500, which is fully covered by insurance. This is the fourth time that the works have suffered from fire visitation since the starting of the Company in 1887. A workman named James Curtis was slightly burned about the face and hands.

DIFFERENT phases of what is known as the "Gas Company Case" have been pending in the District, Supreme and Federal Courts of Iowa for nearly five years. In December, 1888, Messrs. T. C. Carson and Moses Bloom became the owners of the common stock of the Iowa City Gas Company, amounting to $50,000, and the preferred stock, amounting also to $50,000, was held by Messrs. Clark, Coldren and others. The common stock had been pledged by Mr. J. K. Graves, the then owner of it, with the First National Bank of Chicago, as collateral security for an indebtedness which he owed to the bank, with the written contract giving the bank power to sell the stock in case of Graves' default in the payment of his indebtedness to it. Messrs. Carson and Bloom bought the common stock through the bank, and a long contest then commenced in the District Court, and finally ended in the Supreme Court, in which Carson and Bloom were asking a decree compelling the officers of the Company to transfer on the books of the Company the stock which they had purchased. They were successful in both the District and Supreme Courts, the stock was finally transferred, and Messrs. Carson and Bloom secured a standing as stockholders in the Company. A difficulty then arose concerning the election of officers, from the fact that each of the adverse parties held an equal amount of stock, and since the purchase of the stock by Messrs. Carson and Bloom in 1888 no election has in fact been held, though through a decree rendered by Judge Shiras of the Federal Court, in March, 1891, a Board was appointed, consisting of Messrs. E. Clark, W. A. Morrison, T. C. Carson, E. W. Carter and Prof. Hayes. The Board of Directors thus appointed, and as provided by the articles of incorporation of the Company, consisted of five members, but one member (Mr. Bloom) has since died and two others have resigned. It has been found impossible to elect a Board of Directors for the reasons above stated, hence Mr. Carson and the executors of the Bloom estate, as holders of the common stock, appealed to the United States Circuit Court for an order appointing a Receiver and asking that the property and plant of the Company be ordered sold. This application was heard on October 24th, in the United States Circuit Court, at Des Moines, before Judges Shiras and Woolson. The case was argued on behalf of Carson and the Bloom estate by Messrs. J. A. Edwards, of Iowa City, and A. Cummins, of Des Moines, and Attorney Daniels, of Dubuque. When the questions were argued the Court took the papers for examination. The impression is that the Receivership will be granted.

IT is thought that the water gas plant that is being installed at Shelton for the Derby Gas Light Company, of Birmingham, Conn., will be ready for operating on or before the 15th inst.

THE Boston *Herald*, in editorially commenting on the recent changes in the Massachusetts Board of Gas and Electric Light Commissioners has this to say: "In the resignation of the Hon. James W. McDonald from the Gas and Electric Light Commission, the State loses a valuable public official. Mr. McDonald, as Chairman of the Board, has done much to improve the character of the Commissioners' work, and the more thorough methods adopted in consequence have so increased the duties of the members as to demand more time than he can afford to give from his law practice. He came to the Board exceptionally qualified for the work. During his legislative service he had given especial attention to the questions that occupy the Commission. As Chairman of the Committee on Manufactures he reported the municipal lighting bill against an adverse majority, and was champion of the measure in the Senate in carrying it through the body successfully where a similar measure had met defeat in the two preceding years. With this record it was a matter of course that Mr. McDonald should have proved himself a staunch friend of the people as against corporate interests in the exciting controversies over the gas questions last spring, when the doings of the Board were under close scrutiny, and its course, as a body, made it the subject of grave criticism. Col. John T. Wheelwright, who has been appointed to succeed Mr. McDonald, is a man of proved capacity and undoubted integrity, and cannot fail to do honor to the position."

THE local authorities of Bath, Maine, have finally accepted the terms of the contract offered by the Bath Gas and Electric Company for the public lighting of the city, for one year, from September 16th, 1893, to September 16th, 1894. Under the agrreement the city will maintain ten all night and every night arcs (2,000-candle power each), on the basis of a payment of $120 each per annum, and 31 arcs, of equal candle power, to be lighted from dusk to 1:30 A. M., on the basis of a payment of $91 each per annum. This is a square backdown on the part of the city, which had signified its unwillingness to pay in excess of $100 each per annum for all night arcs.

MR. W. STUART SYMINGTON, Superintendent of Public Lamps, Baltimore, Md., reports that at the close of the month 420 arc lamps were in service, against a total of 1,028 in service prior to the fire which wrought such great havoc with the plant of the local Brush Company. About one-half of the territory formerly lighted by the missing arcs has been supplied with gas lamps.

THE Philadelphia *Record* says that the Peoples, Light, Heat, Power and Water Company, of Camden, N. J., which was incorporated on October 25th with a capital of $100,000, intends to become a bidder for the lighting of Camden streets by electric lights. The new Company's incorporators are Henry B. Wilson, President of the Camden National Bank; Edward Dudley, a well-known lawyer and capitalist, and Seldon Twitchell, of Philadelphia, who is identified with the Stockton Water Company. The new Company will become a rival of the Camden Lighting and Heating Company, and a lively fight is anticipated when the Camden Company's present contract with the city expires nine months hence. This contract provides for the lighting of 360 arc lights at $142 35 per light per annum, or a total of $51,246 a year. The controlling spirits of the Camden Company are E. Ambler Armstrong, President of the Board of Public Works, of Camden; ex-Sheriff David Baird, City Solicitor J. Willard Morgan and General William J. Sewell. These gentlemen are prominent in Republican political circles, and much interest will doubtless be manifested in the affair when the fight against them begins. An official of the Peoples Company recently said: "We propose to make a bid to the city of Camden to light its streets for less than $110 per light per annum. This will net the city a saving of $32.35 per lamp every year, or a total of $11,646 on the contract every year. Camden city is badly in need of every dollarshe can save just now, and if it can have its electric lighting furnished for $11,000 less than it is now paying it will be just that much money saved to the taxpayers."

A MEETING of the Committee on Lamps and Gas of the San Francisco Board of Supervisors was held toward the close of October, at which the proposition to order a reduction in the gas rate now charged was discussed at some length. Supervisor Reis suggested that the rate of $2 per 1,000 feet now charged for gas be cut down to $1.90, a reduction of 5 per cent. Supervisor Hinton did not seem to think that the proposed cut amounted to much, stating, for one thing, that it would be no reduction as far as the city government was concerned, since, under the special rate allowed the municipality, only $1.75 per 1,000 cubic feet is paid. The suggested reduction, therefore, would really be an increase so far as the city's own bills were concerned. He insisted that the Supervisors should carry out their pledges as made to the people and order a reduction which should be worth while. Supervisor Stanton deprecated hasty and possibly unjust action. He thought that it was of more importance to observe the obligations imposed by the oath of office, which

bound the members of the Board to do justice by all than to stick blindly to party pledges extorted by political clamor. It was finally decided, on motion of Mr. Hinton, to postpone action for one week and to summon the representatives of the Pacific Gas Improvement Company and the San Francisco Gas Light Company to attend the next meeting for the purpose of furnishing the Committee with all available data as to the cost of manufacturing gas, and also statements of receipts and expenditures, etc.

THE contract for the repairs to be made on the gasholder at Fredericksburg, Va., has been awarded to Messrs. Walsh & McLauchlan, of Richmond, Va.

THE new holder for the Owego (N.Y.) Gas Company will be completed in time for this winter's demand upon it.

THE Philadelphia *Times* says that the natural gas supply was shut off from the people of Saxonburg, Butler county, Pa., and everybody was excited and anxiously inquiring about the cause. The stoppage was caused by a large rooster which had selected the feeding lever as an appropriate resting place.

THE preliminary injunction issued by Judge Thayer restraining the Philadelphia Receiver of Taxes from levying and collecting taxes upon the real estate of the West Manayunk Gas Light Company, at Flat Rock, 21st Ward, Philadelphia (mention of which was made by us last week), has been continued.

THE proprietors of the Le Roy (N. Y.) Gas and Electric Light Company have discontinued the supply of current to incandescent lamps. Reason, no money in the business.

THE Atlanta (Ga.) Gas Company has paid into the city treasury the sum of $10,500, representing back taxes for the years 1891-2-3.

THE Philadelphia Traction Company has placed the order for its new power house with the Berlin Iron Bridge Company, of East Berlin, Conn. The side walls will be of brick and the roof will be of iron. The building, which is 190 feet in width and 168 feet in length, is divided into boiler room, engine room and dynamo room.

THE case of the Citizens Gas Light Company, of Reading, South Reading and Stoneham, vs. the town of Wakefield, Mass., to compel the town to purchase the gas and electric light plant in Wakefield, came up for a hearing on October 25th before the Commissioners recently appointed by the Supreme Court. The Commissioners are Messrs. Edwin B. Hale, Samuel L. Powers and Ira T. Drew, who were appointed to appraise the plant after the case had been considered in court twice, first on a demurrer, then on its merits. In both cases the decision was in favor of the Company. Edgar R. Champlin and Charles R. Darling are counsel for the Company, and Samuel K. Hamilton represents the town. The hearing was held in the office of Commissioner Champlin, No. 5 Tremont street, Boston, and several experts were present to testify in respect to the value of the property under appraisement. Of these only Mr. Prichard, of the Lynn Gas and Electric Light Company, was examined, and that gentleman testified that the plant was worth $250,000. The hearing, which will last for several days, was adjourned on the conclusion of the examination of Mr. Prichard, and when the evidence is all in the Commissioners will make a personal examination of the plant. President Capen, of Tufts College, who is also President of the Company, was among the spectators, and it might be remarked that the proceedings do not seem to attract much attention.

ON the 16th inst. the San Francisco Gas Light Company paid to its shareholders in dividends a sum amounting to $35,000. On the same date the Oakland (Cal.) Company divided $6,000 among its shareholders.

MESSRS. HUBBELL & MCGUIRE attorneys for Messrs. Walter & Beebe, tenants in the Wilder Building, Rochester, N. Y., have brought suit for damages against the Rochester Gas and Electric Company, alleging that the smoke emitted by the works of the defendant has caused them annoyance and loss.

THE residents of Hyattsville, Prince George county, Maryland, have petitioned the Washington (D. C.) Gas Company to extend its mains to their district. Hyattsville is 7 miles northeast of the Nation's capital.

THE question raised by the Roanoke (Va.) Gas and Water Company, and tried a few days ago before Judge Turner, in which the Company claimed that under its charter and franchise the Board of Public Works could not legally demand that it deposit a certified check as a condition of obtaining a permit to disturb the pavements of certain streets in the city, has been decided adversely to the Company. An appeal has been lodged.

The official notification issued to the residents of Scranton and Hyde Park, Pa., by Mr. G. B. Hand, Secretary of the Scranton Gas and Water Company and the Hyde Park Gas Company, respecting a reduction in the gas rate, is appended: "From October 1, 1893, the price of gas will be $1.30 per 1,000 cubic feet consumed, subject to the following discounts: 5 per cent. on all bills where the consumption for the month amounts to less than $25, and 10 per cent. on all bills where the consumption for the month amounts to $25 and upwards, provided the bill is paid on or before the 20th of the month in which the bill is rendered."

THE City Clerk of St. Paul, Minn., advertises for bids for the lighting of the suburban districts of that city by means of gasoline lamps. The competition will close at 1 P.M. to-morrow.

AT a meeting of the Newton (Mass.) City Council an order was adopted authorizing the Legislative Committee and the Mayor to petition the General Court for authority to erect a municipal gas and electric light plant, to furnish lights for the streets, buildings and parks.

THE following account of a case of spontaneous combustion in a pile of coal owned by the San Francisco Gas Light Company was forwarded by a correspondent, who writes under date of October 25th: "During the past few days fire has been raging in the center of a pile of 5,000 tons of coal at the Portero station of the San Francisco Gas Light Company. The fire was discovered through the clouds of smoke that ascended from the pile. Instead of calling out the engines and drenching the heap with water the Gas Company took a different course. Men were put at work digging away the sound coal, and it was hoped the fire would be found comparatively near the top, but this was not the case. In fact, it is likely to take the workmen a week to reach the seat of the trouble. Several hundred tons of the mineral have been already removed, but it is feared that at least 2,500 tons will be ruined. How the fire started is a mystery. The coal was landed in the Company's yard at the foot of Humboldt street two weeks ago, and as no other explanation is forthcoming the cause of the fire is assigned to spontaneous combustion."

A CORRESPONDENT in Boston writes: "A substantial reason why gas is being used more extensively for cooking purposes in Boston in private residences is that people are coming to understand the art of cooking better, and with this comes the knowledge that better cooking can be done with gas than with wood or coal. Usually at this season of the year the concerns that deal in gas stoves do very little business in those used for cooking, most of those sold being put in for heating small rooms. This fall, however, there is a remarkable increase in the call for gas stoves to be used for cooking, and one Company dealing in this sort of goods reports that it has done twice as much business this fall as last. Of course, the reduction in the gas rate has had much to do with the boom."

THE opinion is prevalent that the compromise between the local authorities and the Detroit Gas Company, regarding the rate to be charged for gas in that city, is very far from a realization. Mayor Pingree holds the fort as the obstructionist.

THE offices of the United Gas Improvement Company, at Yonkers, N. Y., were in a very dangerous spot during the conflagration in that city of a few days ago, and the Company is to be congratulated on the good fortune that saved its records and office fixings from obliteration.

THE 26th Ward branch of the Citizens Gas Company, of Brooklyn, N Y., is in good working order. Mention of which brings to mind the fact that Engineer Byrne will soon be at the head of one of the best arranged gas plants in Brooklyn. The improvements on the main plant at 5th street and Gowanus canal are being rapidly carried forward under his careful and competent supervision.

THE Oakland (Cal.) Gas Light and Heat Company established, on the 1st inst., a branch office at Alameda for the convenience of the consumers residing in that district, an act that meets with much kindly comment.

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

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AND GENERAL SCIENCE

MONDAY, NOVEMBER 6, 1893.

The Market for Gas Securities.

The quotations for Consolidated show a slight falling off, the opening figures to-day (Friday) being one point less than those of a week ago, or 135½ to 136. The stock was fairly active, and no doubt much of that which was sold represented transfers on realizing account. Mutual more than held the advance noted last week, and those who ought to know assert that before the holidays the shares will readily bring 150. Equitable is hardening noticeably, the bid price having gone to 175, but no stock is offered at anything under 180. Standard preferred is inquired after, with a tendency on the part of holders to demand a higher figure than that quoted.

Nothing of particular interest has developed in the Brooklyn situation, which becomes every day more strained; but it is likely that a change is close at hand. The Addicks' interest in the gas affairs of Brooklyn is not dead by any means, as the events of a fortnight or so will show. Meanwhile we would recommend old Brooklyn gas as a purchase at 105. Chicago gas is in the descending scale again, at 65¾ to 66. Baltimore Consolidated continues to harden, and is bid for at 60¾. The increase in these share is remarkably even and shows the stability of the Company. Wilmington (Del.) gas is quoted at 180 bid, and Bay State is dull and weaker at 15 to 17.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 WALL ST., NEW YORK CITY.

NOVEMBER 6.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	135½	136
Central	500,000	50	90	95
" Scrip	220,000	—	—	100
Equitable	4,000,000	100	175	—
" Bonds	1,000,000	—	106	108
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	141	—
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	80	95
" Bonds	150,000	—	—	100
Richmond Co., S. I.	346,000	50	50	65
" Bonds	20,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	—	32
Preferred	5,000,000	100	60	65
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	—	105
Citizens	1,200,000	20	50	55
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co.	2,000,000	100	—	—
Bonds	1,000,000	—	25	40
Fulton Municipal	3,000,000	100	120	—
" Bonds	300,000		103	—
Peoples	1,000,000	10	—	75
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	98	100
Metropolitan	870,000	100	115	120
" Bonds (5's)	70,000	—	100	—
Nassau	1,000,000	25	140	—
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	125	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	75	—
2d " " "	3,000,000	1000	—	58
Bay State Gas Co.—				
Stock	5,000,000	50	15	17
Income Bonds	2,000,000	1000	40	—
Buffalo Mutual, N. Y.	750,000	100	110	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
Chicago Gas Company.	25,000,000	100	65¾	66
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	81⅛	81½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Consumers Gas Light Co., Jersey City	2,000,000	100	—	30
Bonds	600,000	1000	—	85
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal.			—	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt.	11,000,000	100	60⅝	60¾
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
1st Mortgage			40	60
East River Gas Co., Long Island City	1,000,000	100	—	—
Bonds	500,000	100	86	87
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	190	200
Laclede Gas Light Co., St. Louis, Mo.—				
Common Stock	7,500,000	100	17½	19
Preferred "	2,500,000	100	65	70
Bonds	9,034,400	1000	81½	82
Louisville, Ky	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	30	—
" Bonds	240,000	100	103	—
New Haven, Conn		25	200	—
Oakland, Cal			42⅝	43
Peoples, Jersey City		—	160	170
" " Bonds			—	—
Paterson, N. J		25	99	102
Rochester, N. Y.		50	80	85
Preferred			90	95
Bonds			90	95
Syracuse, N. Y.	500,000	25	—	—
San Francisco Gas Co. San Francisco, Cal.	10,000,000	100	65½	66
Washington, D. C.	2,000,000	20	240	—
Wilmington, Del.	500,000	50	180	182

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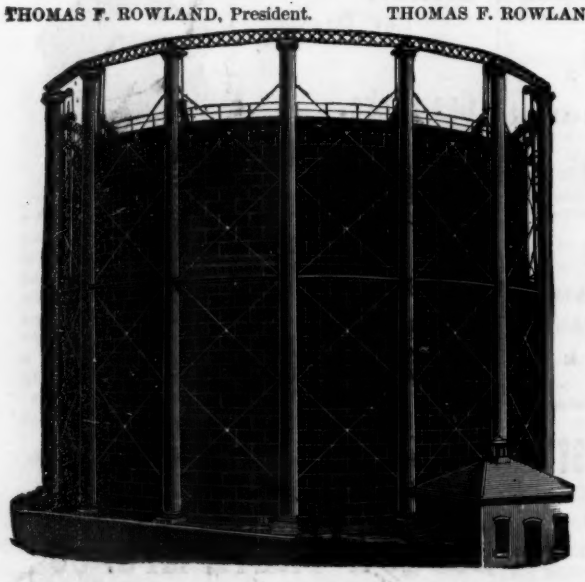

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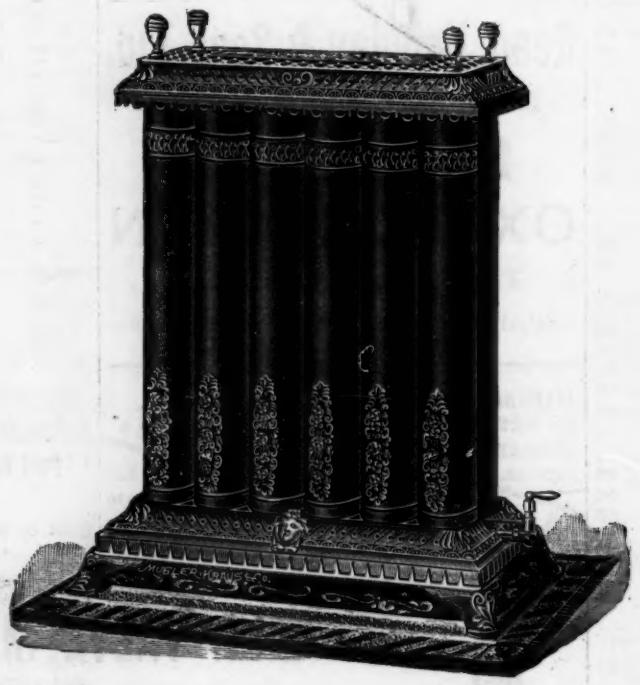

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The HAZELTON BOILER Frequently Called The PORCUPINE BOILER

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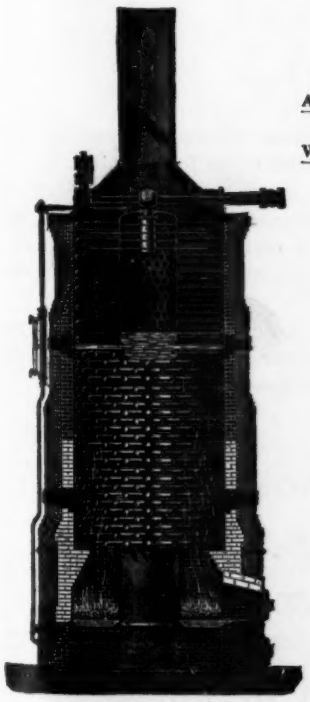

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A Common-Sense High-Pressure Boiler made in a Superior Manner.
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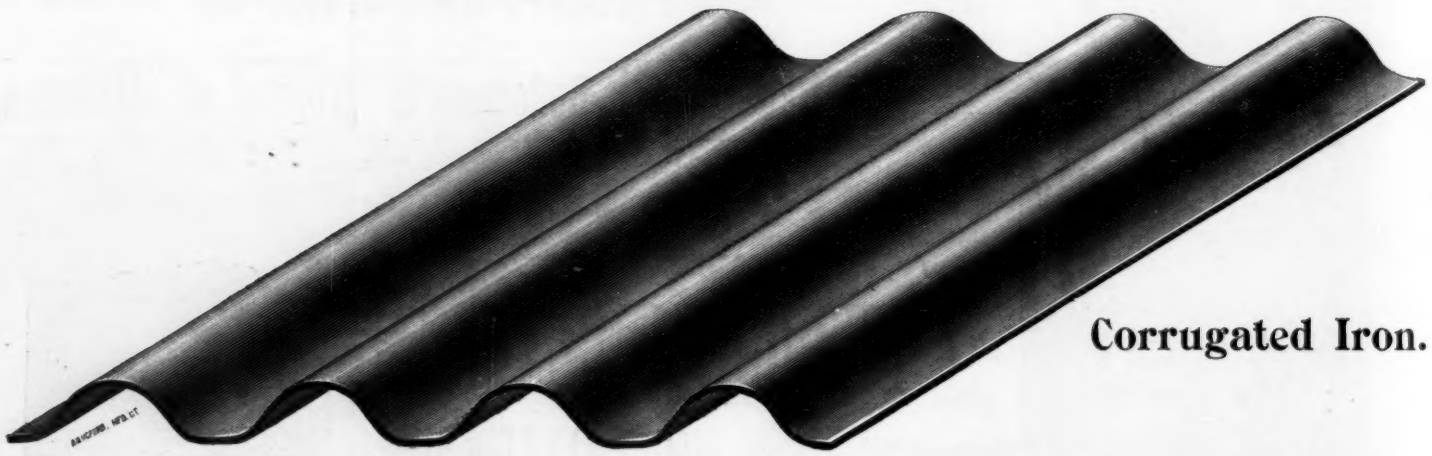

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Dear Sir—In accordance with your request, I have made several ests of the new Welsbach mantel (called No. 169) for candle power and efficiency, and I herewith submit the following results:

	Candle Power.	Pressure.	Gas Consumed.	C.P. per Cu.Ft.
Average of Test No. 1,	67.05	.95 in.	2.6	25.70
" " No. 2,	63.86	1.00 in.	2.86	22.30
" " No. 3,	72.50	2.1 in.	2.87	25.26

The above averages are the results of trials on three different occasions, and in each case the mantles tested were made from a different lot of fluid.

The mantles used in the above tests were selected at random, and all had been dipped in kristaline and dried ready for shipment.

It is quite possible that better results could have been obtained by manipulating and readjusting the position of the mantles on the galleries, and also by waiting a longer period after burning off the kristaline; but I considered such fine adjustment undesirable in determining the commercial candle power.

These tests were made on a bar photometer against a regular Edgerton standard slit. The candle power of the slit was 6.18, and the gas used was Gloucester City water gas, 26 candle power.

Very truly yours,
(Signed) C. H. PAGE, JR., M.E.

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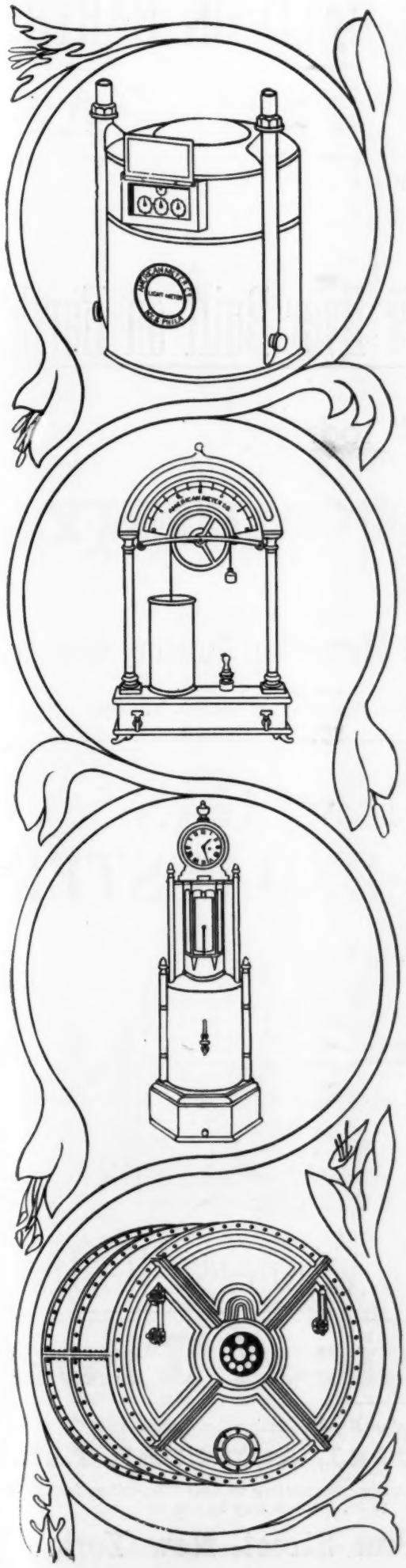

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CHICAGO, CINCINNATI,

ST. LOUIS, SAN FRANCISCO.

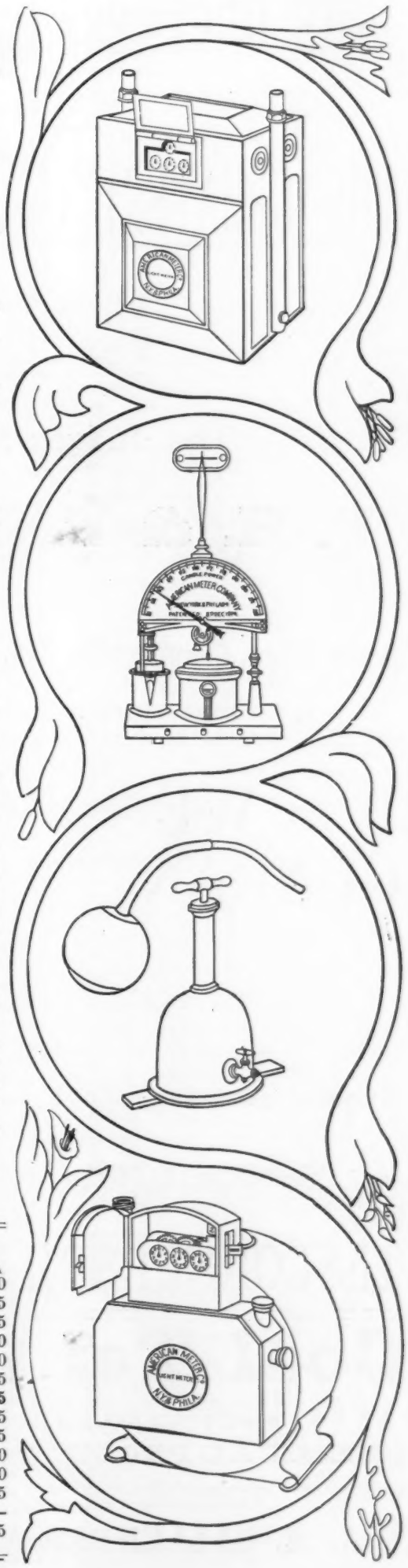
PUBLIC LIGHTING TABLE,

NOVEMBER, 1893.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Wed.	1	5.30 PM	1.10 AM	4.45	5.35
Thu.	2	5.30	2.20	4.45	5.35
Fri.	3	5.30	3.30	4.45	5.35
Sat.	4	5.20	4.30	4.45	5.35
Sun.	5	5.20	5.40	4.40	5.45
Mon.	6	5.20	5.40	4.40	5.45
Tue.	7	5.20	5.40	4.40	5.45
Wed.	8	5.20 NM	5.40	4.40	5.45
Thu.	9	5.20	5.40	4.40	5.45
Fri.	10	5.20	5.40	4.40	5.45
Sat.	11	5.20	5.40	4.40	5.45
Sun.	12	5.20	5.40	4.30	6.00
Mon.	13	7.30	5.40	4.30	6.00
Tue.	14	8.30	5.50	4.30	6.00
Wed.	15	9.30	5.50	4.30	6.00
Thu.	16	10.40 FQ	5.50	4.30	6.00
Fri.	17	11.40	5.50	4.30	6.00
Sat.	18	12.50 AM	5.50	4.30	6.00
Sun.	19	2.00	5.50	4.25	6.00
Mon.	20	3.10	5.50	4.25	6.00
Tue.	21	4.30	5.50	4.25	6.00
Wed.	22	No L	No L.	4.25	6.00
Thu.	23	No L FM	No L.	4.25	6.00
Fri.	24	No L	No L.	4.25	6.00
Sat.	25	5.10 PM	7.20 PM	4.25	6.00
Sun.	26	5.10	8.30	4.20	6.10
Mon.	27	5.10	9.50	4.20	6.10
Tue.	28	5.10	11.00	4.20	6.10
Wed.	29	5.10	12.10 AM	4.20	6.10
Thu.	30	5.10 LQ	1.20	4.20	6.10

TOTAL HOURS LIGHTING DURING 1893.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January...	217.30	January...	423.20
February..	200.30	February..	355.25
March	177.50	March	355.35
April.....	160.30	April.....	298.50
May.....	149.00	May.....	264.50
June.....	140.30	June.....	234.25
July	143.40	July.....	243.45
August....	154.50	August....	280.25
September.	171.50	September.	321.15
October....	202.20	October....	374.30
November.	221.30	November.	401.40
December.	248.50	December.	433.45
Total..	2188.50	Total..	3987.45



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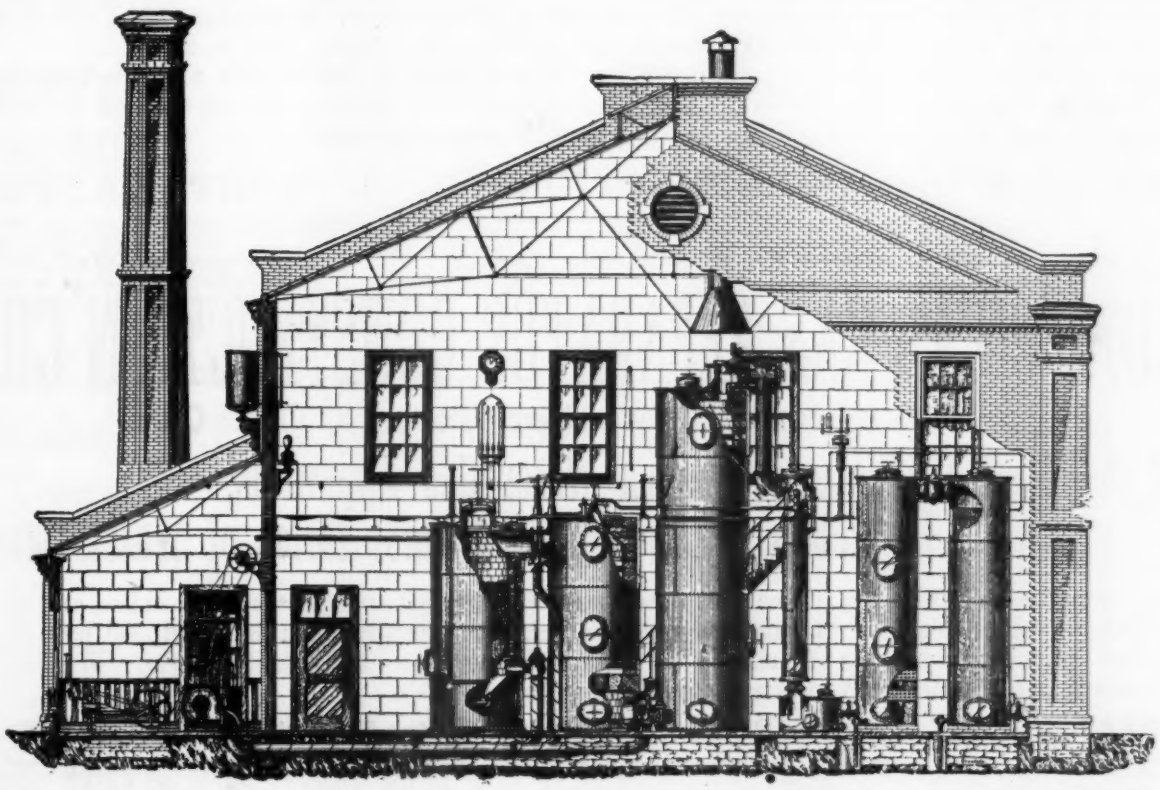

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BY THE

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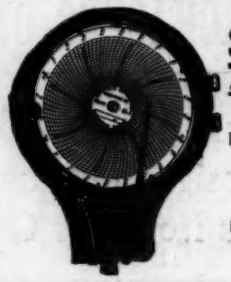

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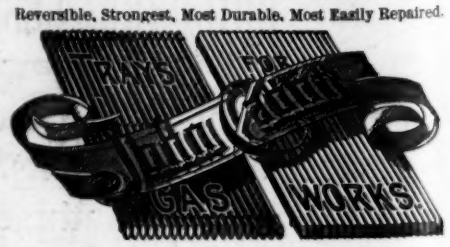

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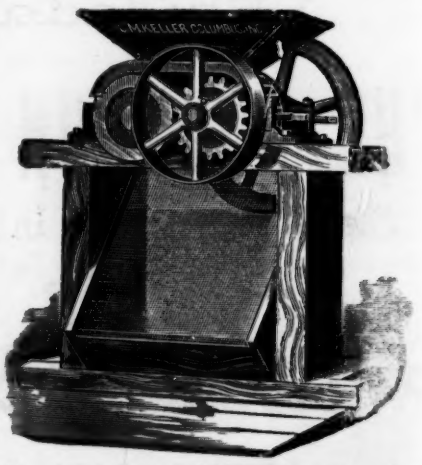

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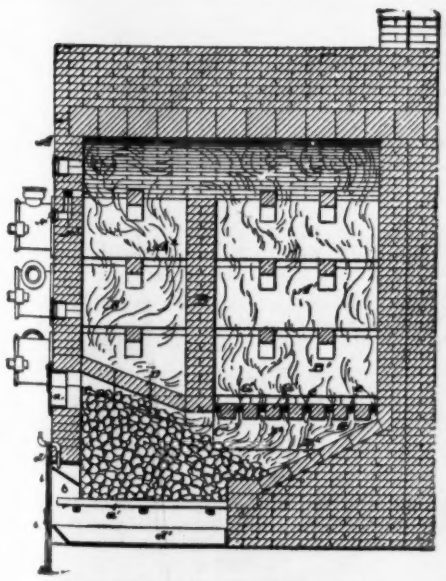

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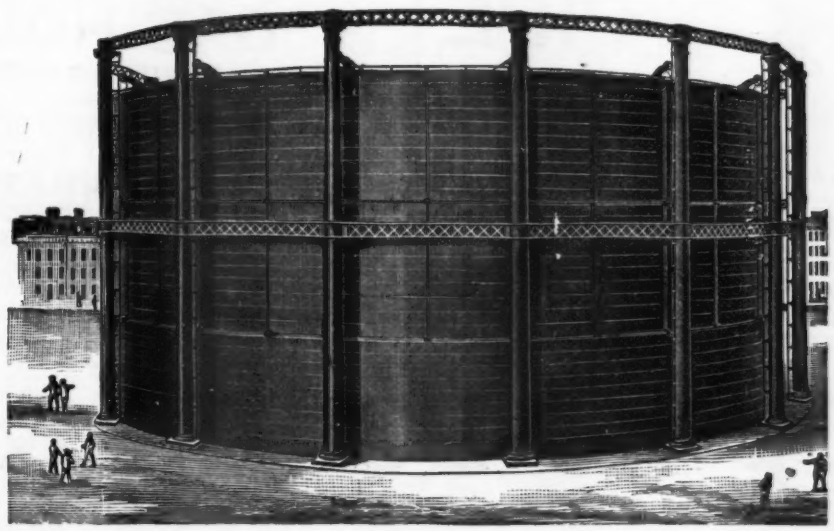

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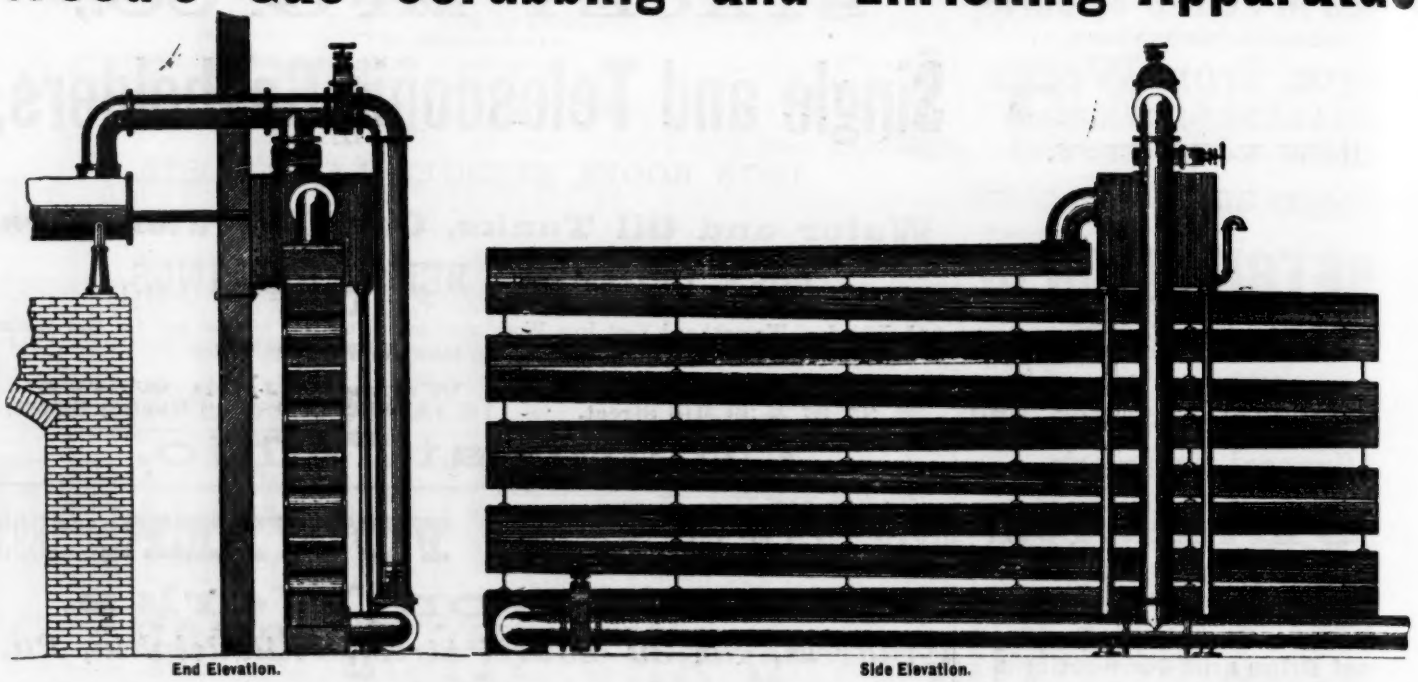

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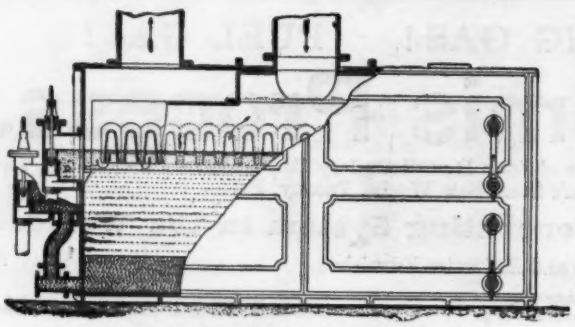

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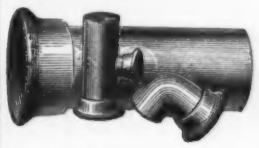

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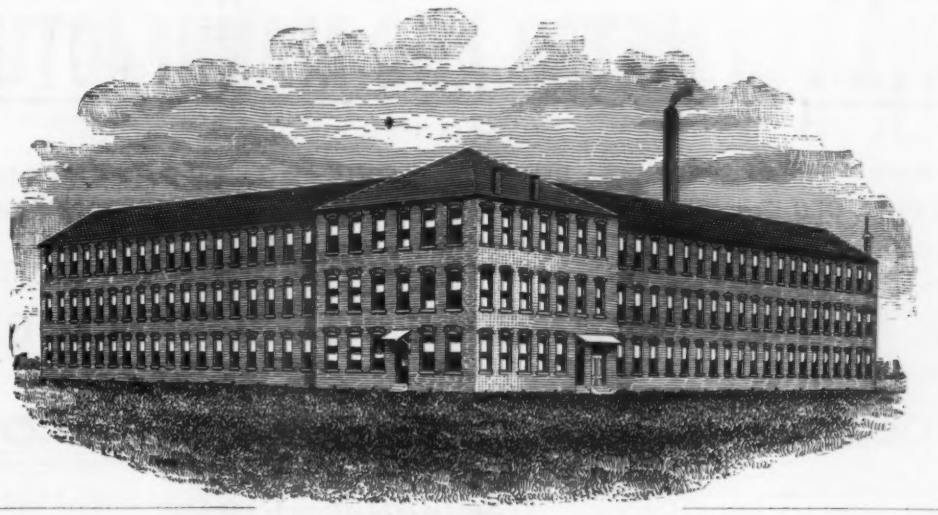

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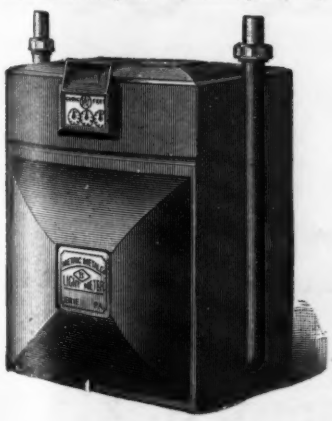

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